EPA/ROD/R10-00/516
2000

EPA Superfund
Record of Decision:

PUGET SOUND NAVAL SHIPYARD COMPLEX
EPA ID: WA2170023418
OU 02
BREMERTON, WA
06/13/2000

DECLARATION OF THE RECORD OF DECISION

SITE NAME AND ADDRESS

Bremerton Naval Complex
Operable Unit B Marine
Bremerton, Washington

STATEMENT OF PURPOSE

This decision document presents the final remedial action for the marine portion of Operable Unit (OU) B, one of four operable units at the Bremerton Naval Complex (BNC) Superfund site in Bremerton. Washington. The Complex has been assigned facility identification number WA2170023418. The selected remedy in this decision document was chosen in accordance with the Comprehensive Environmental Response. Compensation, and Liability Act (CERCLA), as amended, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for OUB.

The U. S. Navy (Navy) is the lead agency for this decision. Both the Washington State Department of Ecology (Ecology) and the U. S. Environmental Protection Agency (EPA) concur with the selected remedy.

ASSESSMENT OF THE SITE

The response action selected in this record of decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This ROD addresses the marine environment of CU B, which includes the nearshore portions of Sinclair Inlet that extend east and west along the shorelines of the Bremerton Naval Complex. OU B is one of four operable units (A, B. C, and NSC) at the Bremerton Naval Complex. The terrestrial sites within CU B (Sites 1, 2, 7,8, 9, 10 East, 10 Central, 10 West, and drydocks) are not addressed in this ROD. With the consensus of EPA and Ecology, only the marine portions of CU B and the nearshore environment of Sinclair Inlet are addressed in this ROD. Decision documents for CU A and CU NSC have been completed; decision documents regarding the terrestrial portion of CU B and CU C are being prepared separately.

The selected remedy for marine CU B addresses human health risks posed by ingestion of seafood and potential environmental risks posed by contaminated sediments and erosion of fill material into the marine environment. The selected remedy includes the following components:

- Approximately 200.000 cubic yards of sediments containing polychlorinated biphenyls (PCBs) will be dredged from an area of approximately 32 acres in the marine portion of CU B and disposed of in excavated confined aquatic disposal (CAD) cells. The CAD cells will be located on Navy-owned submerged land within the boundaries of the BNC.

- A combination of sediment capping and enhanced natural recovery will be used to clean up areas of sediments offshore of the southwestern portion of the Bremerton Naval Complex. The design of the sediment cap will include features for shoreline habitat restoration and will cover approximately 13 acres.

- Shoreline areas at Site 1, in the central portion of the Bremerton Naval Complex, will be stabilized to minimize the potential for erosion of contaminated fill material into the marine environment.

- Marine tissue and sediments will be monitored to document progress toward and attaiiunent of the cleanup goals.

- Land-use restrictions will be implemented by the Navy to maintain the integrity of the CAD cells and the shoreline stabilization measures.

Because of source control and changes in operating practices, the Navy, Ecology, and EPA believe there is no immediate threat of recontamination of sediments.

This is an early action ROD. Early action is being taken so that sediment dredging and disposal components of the remedy can be coordinated with other dredging being conducted by the Navy in support of navigation needs of the Bremerton Naval Complex. Combining the dredging and disposal operations of the two projects enhances the overall implementability and minimizes the short- term environmental effects of the separate projects. Combining the actions will also significantly accelerate the implementation timeframe of the cleanup. Sediments from the navigational dredging that are unsuitable for open-water disposal and sediments from the cleanup action will be disposed of in the on-site CAD cells.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, is in compliance with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. However, treatment of the marine sediments was not found to be practicable. There are no principal threat wastes present at marine OUB, as that term is defined in EPA guidance.

Because this remedywill result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action to ensure that the remedy is protective of human health and the environment.

DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section ofthis record of decision. Additional information can be found in the Administrative Record file for this site.

- Chemicals of concern and their respective concentrations (pages 8-13 through 8-24)
- Baseline risk represented by the chemicals of concern (pages 8-20 and 8-21)
- Cleanup levels established for chemicals of concern and the basis for these levels (page 9-1)
- How source materials constituting principal threats are addressed (page 13-8)
- Current and reasonably anticipated future land-use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (pages 7-1 through 7-3)
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (page 12-l1)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (page 12-14)
- Key factors that led to selecting the remedy (page 12-1)

Signature sheet for the foregoing Bremerton Naval Complex Operable Unit B Marine Record of Decision between the U. S. Navy, the Washington State Department of Ecology, and the U. S. Environmental Protection Agency.

J.A. Holden

J.A. Holden
Captain, U.S. Navy
Commanding Officer, Naval Station Bremerton

6/9/00
Date

G.R. Bryant

G.R. Bryant
Captain, U.S. Navy
Commander, Puget Sound Naval Shipyard

6/12/00
Date

James J. Pendowski

James J. Pendowski
Manager, Toxics Cleanup Program
Washington State Department of Ecology

6/12/00
Date

Chuck Clarke

Chuck Clarke
Regional Administrator, Region 10
U.S. Environmental Protection Agency

6-13-2000
Date

CONTENTS

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

ARAR	applicable or relevant and appropriate requirement
BEHP	bis-2(ethylhexyl) phthalate
BNC	Bremerton Naval Complex
CAD	confined aquatic disposal
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIP	Community Involvement Plan
CLEAN	Comprehensive Long-Term Environmental Action Navy
cmls	centimeter per second
COC	chemical of concern
COC	chemical of interest
COPC	chemical of potential concern
CPA	carcinogenic polycyclic aromatic hydrocarbon
CSF	cancer slope factor
CSL	cleanup screening level (Washington State)
CWA	Clean Water Act
DMTMP	Dredged Material Management Program
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
EPA NW	Engineering Field Activity, Northwest
EPA	U. S. Environmental Protection Agency
EPC	exposure point concentration
ESA	Endangered Species Act
FC	fecal coliform
ES	feasibility study
FSSU	feasibility study sampling unit
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IRIS	Integrated Risk Information System
MCUL	minimum cleanup level
mg/kg OC	milligram per kilogram organic carbon
MLLW	mean lower low water
mph	miles per hour
msl	mean sea level
MTCA	Model Toxics Control Act (Washington State)
MUDS	multiuser disposal site
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOSC	Naval Ocean Surveillance Center
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSB	Naval Station Bremerton
NSC	Naval Supply Center
O&M	operation and maintenance
OC	organic carbon
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene (or perchloroethene)
ppm	parts per million
PRG	preliminary remediation goal
PSAMP	Puget Sound Ambient Monitoring Program
PSEP	Puget Sound Estuary Program
PSNS	Puget Sound Naval Shipyard
RAB	Restoration Advisory Board
RAO	remedial action objective
RBSC	risk-based screening concentration

RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RID	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act
SI	site inspection
SMS	sediment management standard (Washington State)
SQS	sediment quality standard
S/S	solidification/stabilization
SVOC	semivolatile organic compound
TAPP	Technical Assistance for Public Participation
TBC	to be considered
TCE	trichloroethene
T/E	threatened or endangered
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TRC	Technical Review Committee
Tribe	the Suquamish Tribe
TSS	total suspended solids
UCL95	95 percent upper confidence limit
URSG	URS Greiner, Inc.
USFWS	U. S. Fish and Wildlife Service
USGS	U. S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife
WDOH	Washington State Department of Health

DECISION SUMMARY

1.0 INTRODUCTION

The U. S. Navy (Navy), in cooperation with the U. S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology), is carrying out remedial actions at the Bremerton Naval Complex located in Bremerton, Washington (Figure 1-1). This record of decision (ROD) presents the remedial actions selected to address environmental contamination in the marine environment offshore of the Bremerton Naval Complex (BNC; also referred to as the Naval Complex or the Complex). The Navy is the lead agency for this decision document, which reflects concurrence by EPA and Ecology with the selected remedial actions. The remedial actions are also considered responsive to public concerns expressed in the community participation process for this facility.

To support the role of the Complex as a homeport for aircraft carriers, the Navy is planning a large navigation dredging project at the Complex, starting in the summer of 2000. The Navy also plans to replace one of the large piers (Pier D) in the years 2001 through 2003. The Navy, EPA, and Ecology believe there are clear environmental and economic advantages to combining the sediment cleanup of Operable Unit B (OU B) with the planned navigation dredging. Combining the projects would reduce the duration of disruptive activities in the marine environment and lower overall dredging and sediment disposal costs. If the projects cannot be done at the same time, the cleanup will have to be delayed until after 2003, because moored vessels and activities at the Complex will restrict access.

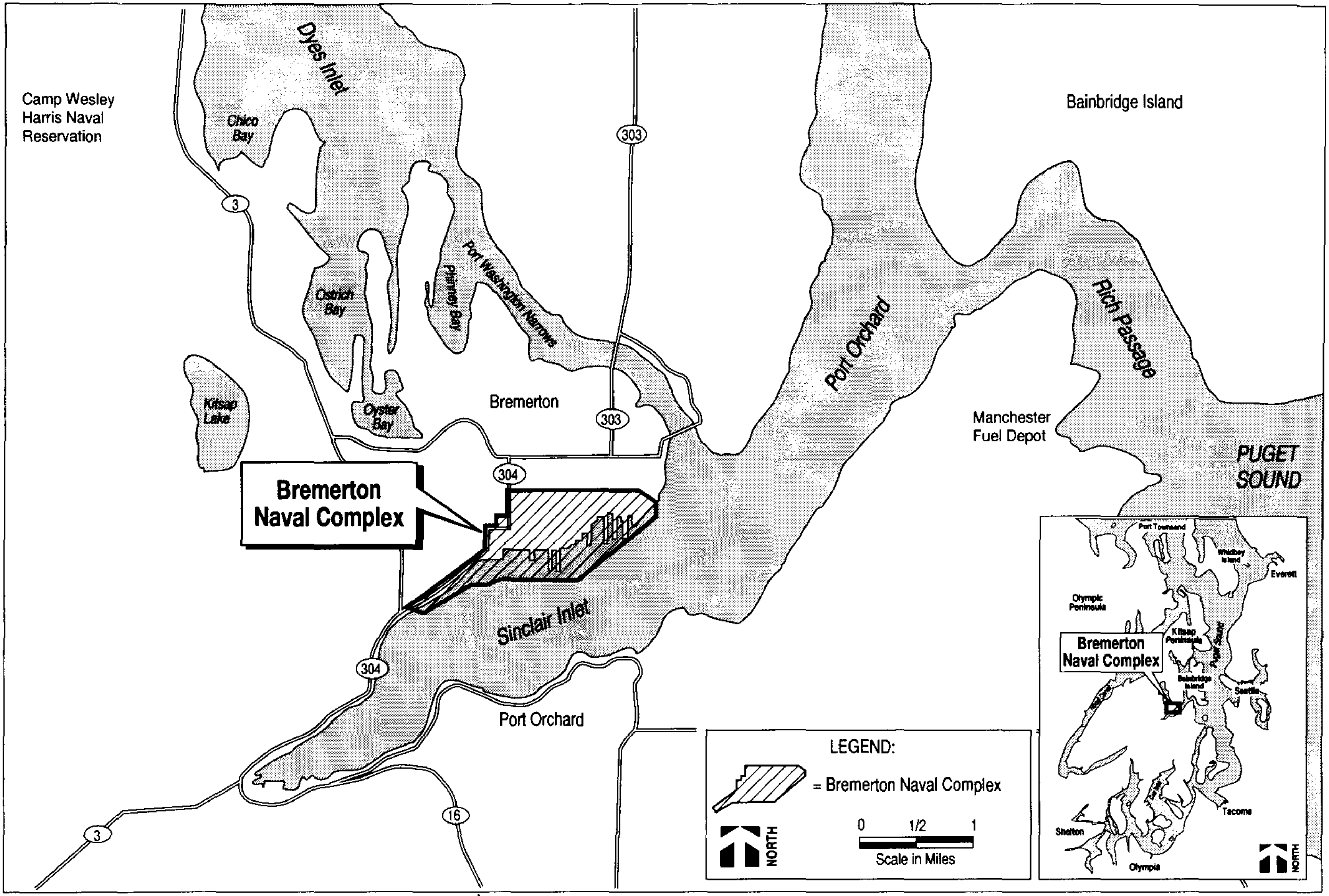
The Navy, EPA, and Ecology believe that a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) early action ROD for marine OU B is in the public interest. The ROD is considered an early action because the remedial investigation and feasibility study (RJIFS) are not complete and final. However, in regard to the marine portion of the site, the data gathered during the RI are sufficient to support a cleanup decision. The early action ROD will enable the Navy to move forward expeditiously with the sediment cleanup, minimize environmental disturbance, achieve economic efficiency, and avoid delay as discussed above.

These actions are being performed by the Navy under the Installation Restoration Program in accordance with Executive Order 12580's delegation of responsibility and authority for implementation of the 1980 CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. To the extent practicable, these remedial actions comply with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300. The Navy's actions are also guided by Washington State regulations, including the Washington State Model Toxics Control Act (MTCA, Revised Code of Washington [RCW] 70.105D), state cleanup regulations (Washington Administrative Code [WAC) Chapter 173-204 and Chapter 173-340), and the specific requirements of MTCA Enforcement Order DE92 TC-112, dated May 15, 1992.

Investigations of Sinclair Inlet sediments have shown that the areas with the highest levels of sediment contamination associated with BNC activities are located comparatively near the Complex shoreline. Contaminant concentrations decrease within about 1,500 feet of the shoreline to approximately the ambient levels found throughout Sinclair Inlet. This area of contamination occurs within a region known as the "exclusion zone," which was therefore adopted as a convenient boundary for the eastern portion of marine OU B. The exclusion zone is a zone of restricted access that extends approximately 1,500 feet into Sinclair Inlet from the BNC shoreline.

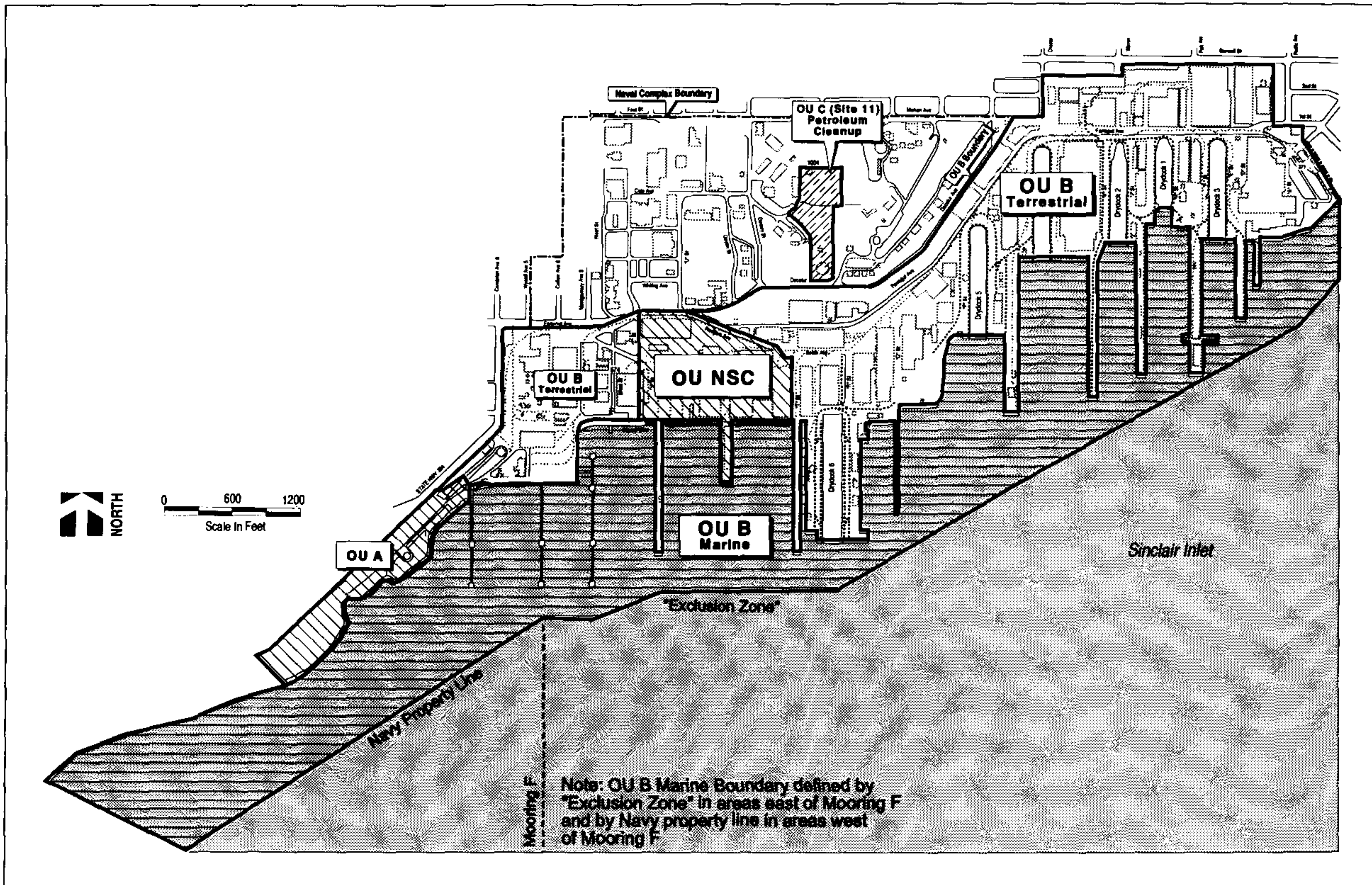
The boundaries of the marine portion of OU B are shown in Figure 1-2. To the northeast the marine portion of OU B is bounded by the Sinclair Inlet shoreline, extending from a point approximately 4,000 feet southwest of Mooring G to the Washington State ferry terminal property line at the northeastern shoreline of the BNC. To the southwest the marine portion of OU B is bounded by the Navy property line in regions west of Mooring F and by the exclusion zone in regions east of Mooring F. This definition includes the proposed confined aquatic disposal (CAD) areas.

OU B contains terrestrial sites (Sites 1, 2, 7, 8, 9, 10 East, 10 Central, lO West, and drydocks) that are not addressed in this ROD (Figure 1- 3). With the consensus of EPA and Ecology, only the marine portions of OU B are addressed in this ROD.



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 1-1** **Bremerton Naval Complex Vicinity Map**	CTO 0131 OU B MARINE Bremerton, WA RECORD OF DECISION

53313104-1-051100

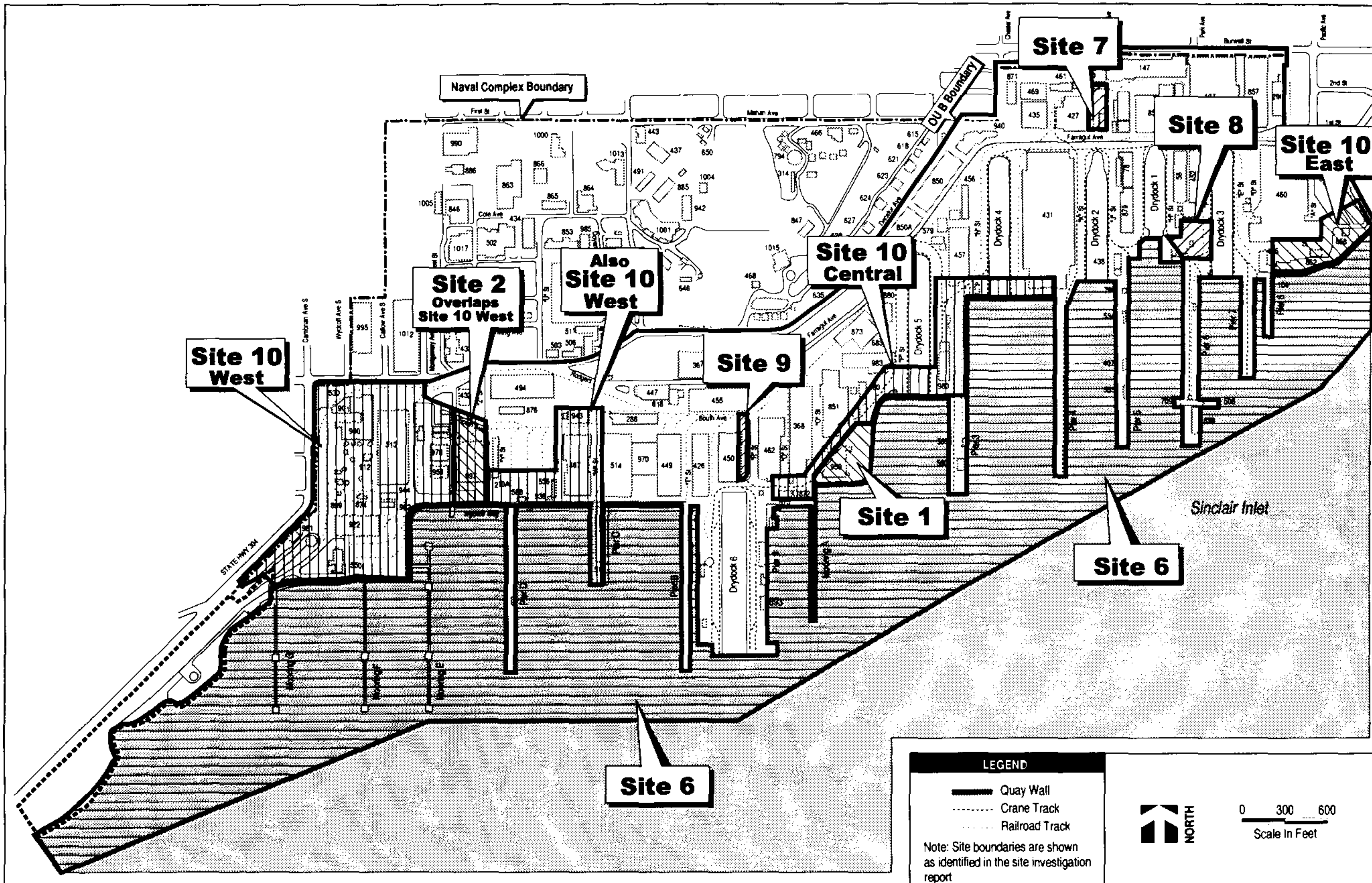


CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 1-2
Bremerton Naval Complex Operable Units

CTO 0131
OU B MARINE
Bremerton, WA
RECORD OF DECISION

53313104-2-051200



CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 1-3
OU B Site locations

CTO 0131
OU B MARINE
Bremerton, WA
RECORD OF DECISION

53313104-3-022699

2.0 SITE NAME, LOCATION, AND DESCRIPTION

2.1 LOCATION

The Bremerton Naval Complex is located in the City of Bremerton, in Kitsap County, Washington (Figure 1-1). The site is physically located at latitude 47° 33’Nand longitude 122° 8W. The Complex includes the Puget Sound Naval Shipyard (PSNS) and Naval Station Bremerton (Figure 2-1). The Navy controls a total of 1,350 acres of property located along the shoreline of Sinclair Inlet, an arm of Puget Sound. Figure 2-2 is an aerial view of the Complex.

The Bremerton Naval Complex has been assigned facility identification number WA2170023418. The Complex was proposed for inclusion on the National Priorities List (NPL) on May 10, 1993, and formally listed on May 31, 1994. The Navy is the lead agency and is performing this work under the Installation Restoration Program. The Navy’s Engineering Field Activity, Northwest (EFA NW), is responsible for the programmatic activities related to cleanup from historical contamination at the Complex. The work is also governed by Ecology’s Enforcement Order DE92 TC-112, dated May 15, 1992.

2.2 SITE DESCRIPTION

The Bremerton Naval Complex consists of two major commands (Figure 2-1): Naval Station Bremerton (NSB) and Puget Sound Naval Shipyard (PSNS). The primary role of Naval Station Bremerton is to serve as a deep draft home port for aircraft carriers and supply ships. Presently, one aircraft carrier and six supply ships are homeported at NSB. Facilities on NSB property include six piers and moorings, the steam plant, parking, and housing, shopping, recreation and dining facilities for military personnel and their families. NSB also serves as host to several tenant commands including the Naval Inactive Ships Maintenance Facility, which has responsibility to provide for long-term care of inactive naval vessels, and the Fleet and Industrial Supply Center, which provides material acquisition and warehouse services to west coast Navy commands. NSB occupies the western portion of the Complex and is a fenced secure area.

The primary role of Puget Sound Naval Shipyard is to provide overhaul, maintenance, conversion, refueling, defueling, and repair services to the naval fleet. PSNS has capabilities to drydock and work on all classes of Navy vessels and is the nation’s sole nuclear submarine and ship recycling facility. PSNS has six drydocks, eight piers and moorings, and numerous industrial shops to support the industrial operations. Like NSB, PSNS is host to many tenant commands. PSNS occupies the eastern portion of the Complex and is a fenced high-security area.

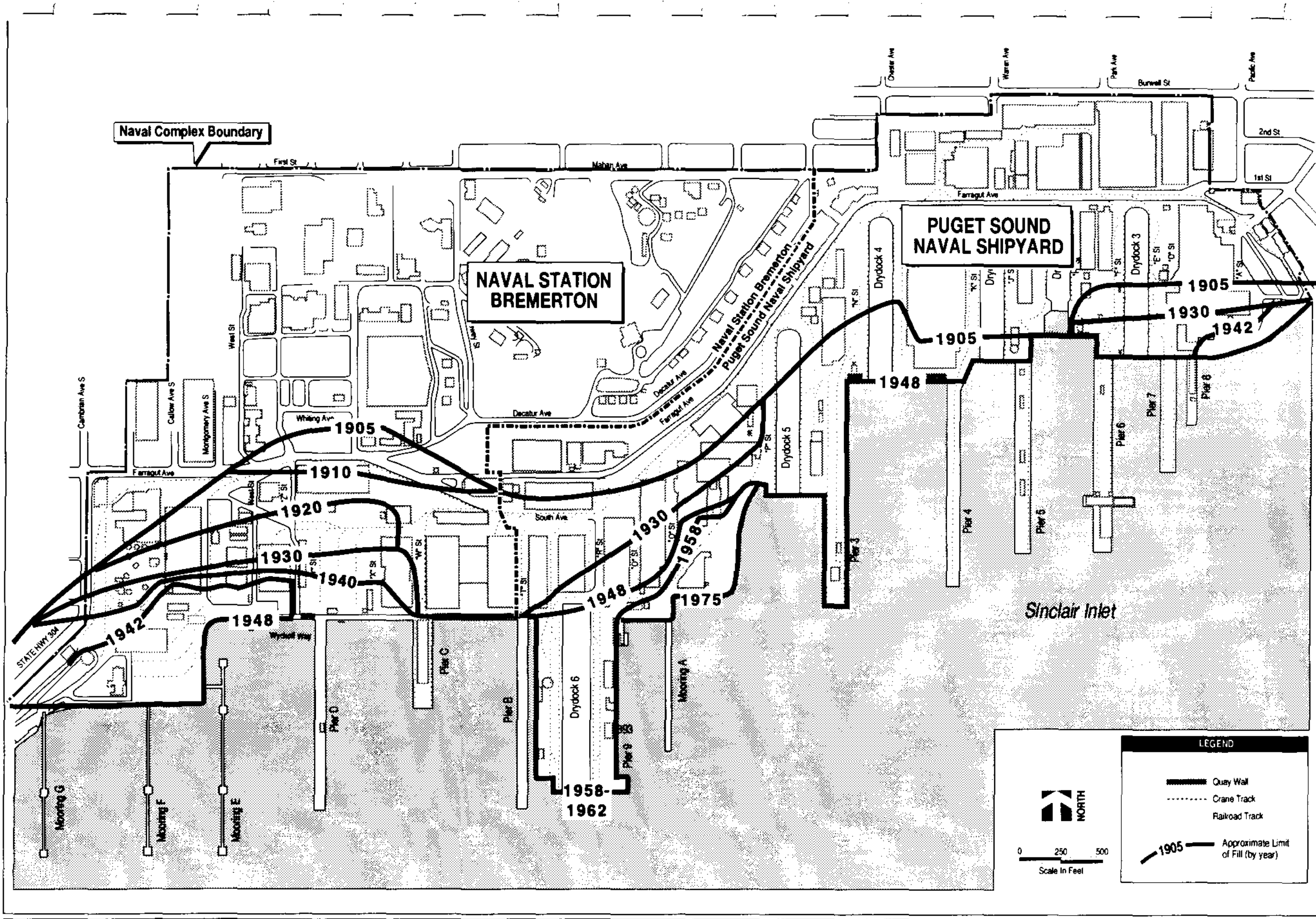
The marine portion of OU B lies primarily within the subtidal zone of Sinclair inlet. A limited intertidal area is present at the southwest portion of the Complex. Piers, drydocks, sea walls, and riprap make up the remaining waterfront area. The marine portion of OU B contains the outfalls for the Complex’s stormwater drain systems, receiving stormwater runoff from the terrestrial portions of the Complex. These discharges occur under a National Pollutant Discharge Elimination System (NPDES) permit. Six drydocks have dewatering systems that remove seawater when ships are docked for maintenance and repair, as well as handling stormwater, groundwater, and seawater seepage into the docks when in use. Three outfalls associated with that system discharge to marine OU B.

The marine portion of OU B contains approximately 230 acres of subtidal land. The area designated for remedial action extends to offshore depths of approximately 40 feet below mean lower low water (MLLW) and up to 1,500 feet offshore from the terrestrial portions of the Complex.

3.0 SITE HISTORY

3.1 BREMERTON NAVAL COMPLEX

The Bremerton Naval Complex became the Pacific Northwest’s first permanent naval installation in 1891. Table 3- 1 shows a chronological history of the installation from the purchase of the original 190-acre site along Sinclair Inlet to its current 1,350 acres and role as a home port for Navy vessels and the Navy’s largest ship repair and overhaul facility on the West Coast. With six major piers, six drydocks, and almost 400 buildings and support facilities, the Bremerton Naval Complex remains a key naval facility in the forefront of aircraft carrier programs, nuclear propulsion and repair capabilities, and numerous specialties.



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 2-1** **Functional Areas and Shoreline Development Within Bremerton Naval Complex**	CTO 0131 OU B MARINE Bremerton, WA RECORD OF DECISION

320

CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 2-2
View to Northeast Over Bremerton Naval Complex

CTO 0131
OU B MARINE
Bremerton, WA
DRAFT RECORD OF DECISION

533131004-327-05100

Industrial activities at the Complex have also been a source of wastes and environmental contaminants since the early 1900s. These wastestreams have included plating wastes, metal filings and shavings associated with metal work, petroleum products, transformers containing polychlorinated biphenyls (PCB5), electrical components, batteries, acids, oxidizing materials, paints and paint chips, degreasing and cleaning solvents, and wood and miscellaneous materials from shipbuilding and ship demolition. Waste disposal practices— particularly the use of miscellaneous waste material as fill during expansion of the Complex (Figure 2-1)— together with spills and leaks of industrial materials have led to elevated levels of various chemicals in the Complex's soil, nearshore sediments, and groundwater. The types of fill encountered during subsurface sampling and the chemicals detected in the fill, sediments, and groundwater are consistent with these types of contaminant sources.

Modem- day industrial operations at the Complex include metal machining, electrical, boilermaking, electronics, print, photo, and paint shops, pesticide operations, transportation operations, fuel storage facilities (aboveground and underground tanks and pipelines), firefighting operations, and medical facilities. Wastes generated by these operations are handled in accordance with current regulations.

3.2 PREVIOUS INVESTIGATIONS

Various studies and investigations have examined the marine sediment, water, and biota in the vicinity of the Complex and Sinclair Inlet. These previous marine studies have been grouped into five categories:

- EPA Urban Action Program
- Watershed investigations
- Ecology wastewater treatment plant inspections
- Sediment monitoring and reconnaissance programs
- Navy CLEAN/ Naval Ocean Surveillance Center (NOSC) investigations

Table 3-2 is a summary description of the historical marine investigations within the Complex and Sinclair Inlet.

Table 3-3 is a summary of Navy investigations and remedial actions that have occurred within or in association with the evaluation of the marine OU B environment. The results of these investigations are discussed in Section 6, Summary of Site Characteristics.

Table 3-1
Summary of Bremerton Naval Complex Site History

Date	Historical Activity or Event
1891	Navy purchases 190 acres of land on Sinclair Inlet for construction of a drydock and base for repair and overhaul.
September 1891	The base is designated the Puget Sound Naval Station: Lt. Ambrose B. Wyckoff assumes command of the region's first naval installation.
Spring 1896	Drydock 1 and miscellaneous support facilities are completed.
1901	The base is redesignated the Puget Sound Naval Yard (PSNY). Support facilities are under construction, including a second drydock (Drydock 2) designed for shipbuilding.
1914—1918	The construction of Drydock 3 occurs during World War I. PSNY has its first change in mission—new vessel construction begins in addition to overhauls. At this time, PSNY is the only shipyard on the West Coast capable of repairing armored battleships.
1919—1921	Upland filling and earthwork expand the industrial area of PSNY. Twenty-five submarine chasers, six submarines, two mine sweepers, seven oceangoing tugs, two ammunition ships, and 1,700 small boats have been commissioned at the yard.
1926	Pier 6, PSNY's largest pier, is constructed.
1930s	Upland expansion continues at PSNY.

Date	Historical Activity or Event
1938—1945	World War II results in a major expansion of PSNY, including additional shore facilities, two new piers, and construction of Drydocks 4 and 5. A total of 394 fighting vessels are built, fitted out, repaired, or overhauled at PSNY during the 44 months of the war.
November 1945	PSNY is renamed the Puget Sound Naval Shipyard (PSNS). Decommissioning of the war fleet becomes a major activity.
1947	Mooring facilities are constructed to berth “mothballed” vessels.
1950—1953	The Korean War places new production demands on PSNS. Modernization of World War II carriers to accommodate modern jet aircraft begins.
mid-l95Os	PSNS begins construction of guided-missile frigates.
1961	Complex becomes part of the Navy’s nuclear powerprogram. Drydock 6 is completed in the early 1960s.
1964	PSNS provides logistical support for all Polaris submarines and support craft assigned to the Pacific Ocean. Ship and submarine overhauls become major activities, as well as construction of the first of the USS Sacramento class of fleet combat support ships.
1967	The Naval Supply Center (NSC) is commissioned at Complex and assigned management responsibility for the Navy’s increasing support needs in the Pacific Northwest.
1970s	After several ships are built in the early 1970s, PSNS ends its mission of new vessel construction and engages exclusively in repair, overhaul, and conversion work.
1973	The closure of naval shipyards in Boston, Massachusetts, and San Francisco, California (Hunter’s Point), increases the Naval Complex’s role in ship repair and refueling for the Pacific fleet.
1975	The Navy begins overhauling aircraft carriers at Complex at a frequency of about one per year. Fill activities occur in the immediate area of Mooring A; the shoreline fill limits match those of the present-day Complex.
1980	Navy files Notice of Hazardous Waste Activity.
July 31, 1990	The preliminary assessment of the Navy’s properties is completed.
March 6, 1992	Washington State Department of Ecology Enforcement Order DE92 TC-006 issued for NSC.
May 15, 1992	Site inspection (SI) report issued.
May 15, 1992	Washington State Department of Ecology Enforcement Order DE92 TC-l12 issued for PSNS.
August 1992	Reorganization of operable units proposed.
January 11, 1993	EPA completes evaluation of Complex according to the Hazard Ranking System, a numeric estimate of relative severity of a hazardous substance release or potential release based on (1) relative potential of substances to cause hazardous situations, (2) likelihood and rate at which substances may affect human and environmental receptors, and (3) severity and magnitude of potential effects.
March 1, 1993	NSC is renamed the Fleet and Industrial Supply Center (FISC).
May 10, 1993	The Bremerton Naval Complex is proposed for inclusion on the National Priorities List (NPL).

Date	Historical Activity or Event
February 1994	Agency for Toxic Substances and Disease Registry site visit to support public health assessment of Naval Complex.
May 31, 1994	Bremerton Naval Complex is added to the NPL.
December 13, 1996	Record of Decision (ROD) is signed for OU NSC
January 24, 1997	ROD is signed for OUA.
August 31, 1998	Navy, EPA, and State of Washington sign interagency agreement for the Complex.

Notes:
EPA - U. S. Environmental Protection Agency
NPL - National Priorities List
NSC - Naval Supply Center
OU - operable unit
PSNS - Puget Sound Naval Shipyard
PSNY - Puget Sound Naval Yard
ROD - Record of Decision

Table 3-2
Summary of Historical Marine Investigations and Monitoring

Date	Title/Source	Description
EPA Urban Bay Action Program [a]		
1988	*Sinclair and Dyes Inlets Action Program: Initial Data Summaries and Problem Identification*. Prepared for U. S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, Washington, by Tetra Tech, Inc.	This study summarized historical data regarding contaminant sources and analytical testing for contamination of the water column, sediments, and biota. Geographical problem areas, the apparent extent and severity of environmental degradation, and data gaps were identified. Sediment analyses documented elevated levels of PAHs, PCBs, and metals (mercury, copper, lead, zinc) in the vicinity of the Complex. Sediment toxicity (as measured by amphipod bioassays) and histopathology (liver lesions in English sole) were documented.
1990	*Sinclair and Dyes Inlets Urban Bay Action Program: 1990 Action Plan.* EPA 910/9-90-013. Prepared for U. S. Environmental Protection Agency by PTI Environmental Services.	This plan described and set priorities for problem areas within Sinclair Inlet. Organic and inorganic substances measured in Complex sediments were higher than observed in reference areas. Sediment contamination sources cited included spills, leaks, surface water runoff, direct or indirect discharges, and past disposal of wastes from shipbuilding and repair activities.
Watershed Investigations [b]		
1983	*Initial Assessment Study of Naval Shipyard Puget Sound, Bremerton, Washington*. NEESA 13-022. Prepared by Naval Energy and Environmental Support Activity (NEESA), Port Hueneme, California.	Identified and assessed environmental contamination from historical materials storage, transfer, processing, and disposal at Complex. Identified Sites 1 through 6 and made recommendations for controlling potential contamination.
1988	*Sinclair and Dyes Inlets Action Program: Initial Data Summaries and Problem Identification*. Prepared for U. S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle. Washington, by Tetra Tech, Inc.	This study summarized historical data regarding contaminant sources from analytical testing of the water column, sediments, and biota for contamination. Fecal coliform concentrations exceeded EPA screening criteria near the Bremerton wastewater treatment plant and at 4 of 10 sampling locations near the Complex.
1990	*Sinclair Inlet Watershed, Kitsap County, Washington*. Prepared for Sinclair Inlet Watershed Management Committee by Puget Sound Cooperative River Basin Team.	Over 20 streams were identified that drain into the Sinclair Inlet watershed and influence the surface water quality within the basin. None of the streams flow through the Complex.
1991	*Sinclair Inlet Water Quality Assessment*. Prepared for Sinclair Inlet Watershed Management Committee, Kitsap County Department of Community Development, by Envirovision.	Water quality data collected from surface water sources that drain to Sinclair Inlet were discussed in this assessment. Freshwater sources are estimated to represent less than 1 percent of the total volume of water exchanged in each tidal cycle. Elevated concentrations of organotin, a common ingredient in marine paints, were detected in Sinclair Inlet. Although organotin-containing paints have not been used at the Complex since 1980, they were likely present on hulls of vessels undergoing maintenance.
1991	*Nutrients and Phytoplankton in Puget Sound*. EPA 910/9-91/ 002. Prepared for Puget Sound Estuary Program by Rensel & Associates and PTI Environmental Services.	This study of Puget Sound listed Sinclair Inlet as a “potentially nutrient-sensitive area.” The Complex was not identified as a source of nitrogen or phosphorus impact to the inlet.

Table 3-2 (Continued)
Summary of Historical Marine Investigations and Monitoring

Date	Title/Source	Description
1990	*Puget Sound Ambient Monitoring Program; Marine Sediment Monitoring Program Annual Report 1990*. Publication No. 97-47. Prepared for Washington Department of Ecology, Ambient Monitoring Section, Olympia. Washington, by P. L. Striplin, P. J.Sparks-McConkey, D. A. Davis, and F. A. Svendsen.	Sediments tested at Station 34 contained elevated metals (mercury, lead, silver, and zinc), PAHs, and butylbenzylphthalate, Mercury concentrations were the highest measured in sediments from the study’s locations throughout Puget Sound. Bioassay mortality (27 percent) was attributed to grain-size effects.
1992	*Sinclair Inlet Watershed Long-Term Water Quality Assessment Phase I: Status Report No. 2*. Prepared by Bremerton/ Kitsap County Health District.	This study assessed temperature, dissolved oxygen, and fecal coliform concentrations at water sampling stations in Sinclair Inlet. Three stations in the vicinity of the Complex met state standards for fecal coliforms.
Ecology Wastewater Treatment Plant Inspections c		
1988	*Bremerton Wastewater Treatment Plant Class II Inspection*. Prepared by D. Reif Washington State Department of Ecology, Water Quality Investigations Section. Olympia, Washington.	Sediment bioassays using an amphipod (*Rhepoxynius abronius*) were conducted for the Bremerton wastewater treatment plant’s outfall area. Mercury and phthalate concentrations exceeded sediment quality standards. The bioassays did not indicate substantial or significant toxicity at any of the sediment sampling locations.
1990	“Port Orchard Wastewater Treatment Plant Class II Inspection, January 1989.” Memorandum from L. Zinner to J. Faigenblum, Washington State Department of Ecology. Olympia, Washington.	Sediment bioassays using an amphipod (*Rhepoxynius abronius*) and the bacterial luminescence (Microtox) test were conducted for the Port Orchard wastewater treatment plant’s outfall area. Mercury and bis(2-ethylhexyl) phthalate concentrations exceeded sediment quality standards at one or more stations. The bioassays did not indicate substantial or significant toxicity at any of the sediment sampling locations.
Sediment Monitoring and Reconnaissance Program		
1990	*Puget Sound Ambient Monitoring Program 1989: Marine Sediment Monitoring, Final Report*. TC 3838. Prepared for Washington State Department of Ecology, Ambient Monitoring Section, Olympia, Washington, by Tetra Tech, Inc.	The Puget Sound Ambient Monitoring Program (PSAMP), sponsored by the Washington State Department of Ecology, assessed baseline ecological conditions and spatial and temporal trends in sediment quality throughout Puget Sound. In 1989, PSA1s4P established one monitoring station (Station 34) in Sinclair Inlet, at the Complex boundary (1 km southwest of Mooring G) and about 0.5 kin south of the Bremerton wastewater treatment plant. Sediment analyses detected PCBs, PAHs, butylbenzylphthalate, and elevated metals (mercury, copper, and zinc). Sediment toxicity (amphipod and Microtox bioassays) and benthic community analyses did not indicate adverse effects, but the station was not considered usable as a reference area for ambient conditions because of the presence of sediment contaminants.
1990	*Puget Sound Ambient Monitoring Program; Marine Sediment Monitoring Program Annual Report 1990*. Publication No. 97-47. Prepared for Washington Department of Ecology, Ambient Monitoring Section, Olympia. Washington, by P. L. Striplin, P. J.Sparks-McConkey, D. A. Davis, and F. A. Svendsen.	Sediments tested at Station 34 contained elevated metals (mercury, lead, silver, and zinc), PAHs, and butylbenzylphthalate, Mercury concentrations were the highest measured in sediments from the study’s locations throughout Puget Sound. Bioassay mortality (27 percent) was attributed to grain-size effects.

Table 3-2 (Continued)
Summary of Historical Marine Investigations and Monitoring

Date	Title/Source	Description
1990	*Macrobenthic Community Changes in Response to Contaminated Sediments: Sinclair Inlet, Washington*. Prepared for U. S. EPA, Region 10, Seattle, Washington, by D. P. Weston under Cooperative Agreement CE-000408-0l.	This paper, prepared for the U. S. EPA. Region 10, described investigations of the macrobenthic community in Sinclair Inlet. The work in Sinclair Inlet investigated the potential toxic effects from Complex activities, primarily inorganics, on benthic infaunal communities. Chemical analyses of sediments from five sampling stations: three in the vicinity of Piers 3 and 4, one in the center of the inlet, and one on the south side of the inlet. PAHs and metal concentrations in the vicinity of the Complex were 2 to 5 times those measured in the other stations. A number of descriptive biological indexes were evaluated for evidence of a benthic infauna response to inorganic releases; most proved to be insensitive measurements. Species richness (number of species per cubic meter of sediment) and species relative abundance (dominance or absence of species) were correlated with inorganic concentrations near the piers. The study indicated that, on avenge, 9 species per sample were obtained in stations within the Complex, while 18 species were obtained in the inlet stations. The polychaete *Capitella cf. Capitata* dominated the samples from the Complex Stations, but was absent in the other stations. The echinoderm *Amphiodia urtica* was absent from the Complex samples, but present in the inlet stations.
1991	*Puget Sound Sediment Reconnaissance Survey, 1991, Final Summary Report*. Prepared for Washington Department of Natural Resources, Division of Aquatic Lands, Enumclaw, Washington, by Tetra Tech, Inc.	This study was sponsored by the Washington State Department of Natural Resources' Division of Aquatic Lands to identify publicly owned contaminated aquatic lands in Puget Sound. The study focused on areas near small municipalities with light-to-medium industry. The study produced background data for Sinclair Inlet and seven other locations in Puget Sound; it did not specifically evaluate the Complex. Four sampling stations were evaluated in Sinclair Inlet, with two located in the vicinity of municipal wastewater outfalls. Elevated metals (mercury, copper, and zinc) and bis(2-ethylhexyl) phthalate were documented.
1992	*Contaminants in Fish and Clams in Sinclair and Dyes Inlets*. Prepared for Washington State Department of Ecology, Olympia, Washington, by J. Cubbage	The bioaccumulation of chemicals in marine organisms (i.e., bottom fish and clams) in Sinclair and Dyes Inlets was investigated. Although none of the sampling stations were located within the Complex, the study has been used as a source for background data. Fish samples were collected from four sampling stations in Sinclair Inlet. Clams were taken from two sampling stations on the south shore of Sinclair Inlet. High concentrations of arsenic, lead, and mercury were found in fish from the stations closest to the confluence of the Port Washington Narrows and Sinclair Inlet. Metals (cadmium, silver, copper, and zinc) and PAHs were found in Sinclair Inlet clams. The pesticide dichlorodiphenyl-dichioroethylene (DDE) was detected in fish, but no PCBs were detected.

Table 3-2 (Continued)
Summary of Historical Marine Investigations and Monitoring

Date	Title/Source	Description
1998	*Water Velocities and the Potential for the Movement of Bed Sediments in Sinclair Inlet of Puget Sound, Washington*. Prepared for U. S. Geological Survey, Tacoma, Washington, by J. W. Gartner, E. A. Prych, GB. Tate, D. A. Cacchione, T. T. Cheng, W. R. Bidlake, and J. T. Ferreira.	This study was conducted to provide information concerning the potential for sediment resuspension in the inlet. The study was intended to evaluate whether contaminated sediments in the vicinity of the Complex could be resuspended by tide- and wind-driven currents and transported within the inlet or out of the inlet to other parts of Puget Sound. Water-current profiles from 2 meters above the sediment bed to 2 meters below the water surface were monitored at three stations during the winter and summer of 1994. Water currents measured at the three stations were relatively weak, with typical speeds of 5 to 10 cm/sec; tidal and residual currents were of similar magnitude. The root-mean-square value of the total shear velocity ranged from 0.31 to 0.44 cm/sec. The skin-friction component of the shear velocity was estimated to be no more than half the total. Critical shear velocity, estimated from particle sizes and density of the bed material, was 0.39 cm/sec or more. The study concluded that resuspension occurs only infrequently, usually at times of maximum current during the tidal cycle.

a The goal of this EPA-sponsored program is to protect marine and estuarine habitat from further degradation by human activities, identify degraded areas amenable to restoration, and protect recreational uses. Sinclair Inlet was assessed under this program.

b General watershed investigations of Sinclair Inlet were referenced by the Navy to characterize freshwater sources and impacts.

c Inspections of existing wastewater treatment facilities were referenced to characterize major permitted discharges to Sinclair Inlet.

Notes:

cm/sec - centimeter per second
EPA - U. S. Environmental Protection Agency
km - kilometer
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl

Table 3-3
Summary of Marine OU B Investigations and Remedial Actions at the Bremerton Naval Complex

Date	Title/Source	Description
1990	*Site Inspection Study at Puget Sound Naval Shipyard, Bremerton, Washington. Sampling and Analysis Plan*. Prepared for U. S. Navy EFA NW, Poulsbo, Washington, under CLEAN Contract N62474-89-D-9295, by URS Consultants, Inc.	The Navy initiates work at the Bremerton Naval Complex under its Comprehensive Long-Term Environmental Action Navy (CLEAN) contract with URS Consultants, Inc.
1992	*Site Inspection Study, Puget Sound Naval Shipyard Site Inspection Report, Bremerton, Washington*. Prepared for U. S. Navy EFA NW, Poulsbo, Washington, under CLEAN Contract N62474-89-D-9295, by URS Consultants, Inc.	The site inspection was conducted in late 1990. Characterization of sediments for inorganic and organic contaminants was done at 54 marine sampling stations, including 40 located within OU B Site 6. Three of the stations were located in lower Sinclair Inlet and Port Orchard Inlet. Fourteen of the stations were used to characterize surface waters and study benthic infaunal communities. The site inspection documented the presence of a variety of metals and semi-volatile organic chemicals at concentrations exceeding the screening criteria of three-times background levels and established marine sediment criteria. The study results were used to support consideration of the site for inclusion on the National Priorities List.
1992	*An Evaluation of Contaminant Flux Rates From Sediments of Sinclair Inlet, Washington, Using a Benthic Flux Sampling Device.* Draft Report. Prepared for Naval Command, Control and Ocean Surveillance Center, Marine Environmental Quality Branch, San Diego. California, by DR. Chadwick, S. H. Lieberman, CF. Reimers, D. Young, and R. K. Johnson.	Scientists from NOSC, EPA. and the Scripps Institute of Oceanography evaluated rates of chemical flux into and out of sediments at seven locations in the vicinity of OU B and three reference stations in Sinclair Inlet. The flux studies indicated that arsenic, nickel, and zinc were released from the sediments at measurable rates. Trace metals showed little or no release, because of the strongly reducing characteristics of the local sediments. PAHs were released from sediments in two areas. The analysis suggested recent inputs of low-molecular-weight PAHs from Complex activities, as well as the release of high-molecular-weight PAHs from previously contaminated sediments as a result of bioturbation. The study concluded that, where releases of contaminants were found, the sediments did not represent a significant source relative to other major inputs, such as sewer discharges, nonpoint-source runoff, and marinas.
1993	*Hydrogeological and Biological Investigation, Puget Sound Naval Shipyard, Bremerton, Washington: Biological Report.* Prepared for U. S. Navy EFA NW, Poulsbo, Washington, under CLEAN Contract N62474-89-D-9295, by URS Consultants, Inc.	In conjunction with the site inspection, 12 sampling stations located offshore of the Complex and 2 reference stations were sampled to characterize the benthic communities and the physical and chemical conditions in the surrounding sediments. Benthic community structure was analyzed using a variety of descriptive statistics and biological indices. The biological data indicated that the benthic communities were stressed in the vicinity of the Complex, but none of the abundance indices for major taxonomic groups exceeded Washington Marine Sediment Quality Standards (SQS) for biological effects. The four stations with the most biological disturbance and potential chemical stress were located inshore near Complex docks and piers. Among these stations, two to seven chemicals exceeded SQS values.

Table 3-3 (Continued)
Summary of Marine OU B Investigations and Remedial Actions at the Bremerton Naval Complex

Date	Title/Source	Description
1994	*Final Project Plans: Work Plan, Field Sampling Plan, Quality Assurance Project Plan, Health and Safety Plan for the Remedial Investigation/Feasibility Study (RI/FS), Operable Unit B, Puget Sound Naval Shipyard, Bremerton, Washington*. Prepared for U. S. Navy EFA NW, Poulsbo, Washington, under CLEAN Contract N62474-89-D-9295, by URS Consultants, Inc.	These project management plans for the remedial investigation (RI) defined the approach, procedures, and methods for evaluating OU B, including marine investigations. The goals of the RI included determining the nature and extent of chemicals of interest in marine OU B, environmental fate, and the potential risks to human health and the environment. The RI was organized in two phases, with Phase I results used to define and guide the Phase II investigations.
1995	Final Addendum to Management Plans, Remedial Investigation/Feasibility Study, Operable Unit B, Phase II, Puget Sound Naval Shipyard, Bremerton, Washington; and Final Supplement to Final Addendum to Management Plans, Remedial Investigation/Feasibility Study, Operable Unit B, Phase II, Puget Sound Naval Shipyard, Bremerton, Washington. Both documents prepared for U. S. Navy EFA NW, Poulsbo, Washington, under CLEAN Contract N62474-89-D-9295, by URS Consultants, Inc.	The final addendum defined supplemental investigations to address data gaps identified under Phase I work, including a revised conceptual site model, and specific questions regarding the nature and extent of contaminants in the marine environment and their fate and transport mechanisms. Phase II tasks included additional sampling and analysis of marine sediments and characterization of storm drain water and drydock discharges to Sinclair Inlet. Sea cucumber tissue sampling was added to the biological testing program, as well as histopathology analyses of English sole tissue samples collected in Phase I. The final supplement addressed storm drain and drydock outfall sampling, marine sediment collection, and selective bioassay retesting to correct for performance problems experienced in Phase I bioassays. Critical outfalls and drydocks were sampled to determine the potential impact of these discharges on the marine environment.
1998	*A Sediment Trend Analysis (STA®) of Sinclair Inlet/Port Orchard*. Prepared for U. S. Navy EFA NW, Poulsbo, Washington, under CLEAN Contract N62474-89-D-9295, by URS Consultants. Inc., and GeoSea Consulting (Canada) Ltd.	Sediment trend analysis was performed on 349 samples from Sinclair Inlet and the Port Orchard waterway. Separate analyses were performed for sandy sediments (greater than 50 percent by volume) and muddy sediments. Most of the inlet consists of muddy sediments; sandy sediments are confined to intertidal areas along the south side of the inlet. The analysis indicated that the muddy sediments of Sinclair Inlet have a dominant clockwise transport pattern, with flood-directed transport on the south side and ebb directed transport on the north side. Nearly all the pathways terminate inside the docks of the Complex. Statistically significant trends for deposition and erosion were found for most sample lines, suggesting significant amounts of resuspension by processes such as propeller wash from vessels.
1999	*Draft Technical Memorandum for Results of Feasibility Study Sediment Sampling*. Prepared for US. Navy EFA NW, Poulsbo, Washington. under CLEAN Contract N62474-89-D-9295, by URS Consultants, Inc.	Polychlorinated biphenyl (PCB) and total organic carbon (TOC) analyses were performed on 98 sediment samples from Sinclair Inlet (primarily within the Bremerton Naval Complex exclusion zone) and on 10 samples from the Port Orchard Waterway. Results from the Sinclair Inlet samples were used to define areas requiring remedial action, to support the feasibility study and remedial design. Results from the Port Orchard Waterway samples were used to represent newly depositing sediments in Sinclair Inlet, in support of natural recovery modeling.

Table 3-3 (Continued)
Summary of Marine OU B Investigations and Remedial Actions at the Bremerton Naval Complex

Date	Title/Source	Description
2000	*CAD Site Sediment Characterization Report, Nearshore Confined Aquatic Disposal, Operable Unit B*. Prepared for U. S. Navy EFA NW, Poulsbo, Washington, by Foster Wheeler Environmental.	Sediments from proposed pit confined aquatic disposal (CAD) location were sampled and analyzed to determine suitability for open-water disposal.
2000	Sediment characterization report [document in progress]. Prepared for U. S. Navy EFA NW, Poulsbo, Washington, by SAIC,	Sediments from navigational dredging areas were sampled and analyzed to determine their suitability for open-water disposal.
2000	*PCB Levels in Bottom Sediments From Lower Sinclair Inlet*. Washington State Department of Ecology, Olympia, Washington.	Presents results of shallow sediment sampling and analysis performed by Ecology in inlet distant from OU B.

Notes:
EFA NW- Engineering Field Activity, Northwest
EPA - Environmental Protection Agency
NOSC - Naval Ocean Surveillance Center
OU B - Operable Unit B
PAM - polycyclic aromatic hydrocarbon
RI - remedial investigation

4.0 COMMUNITY RELATIONS

The Navy published a Community Involvement Plan (CIP) for the Bremerton Naval Complex in April 1996, replacing the Community Relations/ Public Participation Plan published in October 1992. The new plan's goals are as follows:

- To encourage communication between the Navy and local community
- To encourage public participation in decision making
- To focus on issues of interest to the community during the study and cleanup process
- To be open to change based on community involvement needs

In 1994, the Bremerton Naval Complex began a transition from the regulatory agency-based Technical Review Committee (TRC) to a community- based Restoration Advisory Board (RAB). To ensure the community had sufficient opportunity to participate in the process, 26,000 brochures were mailed to the surrounding community. The address list included all residences and businesses within I mile of the Complex, as well as elected officials, religious groups, environmental activists, medical professionals, news media, and ethnic groups. Additionally, a series of open houses were held to provide information on cleanup and allow the community to ask questions about the RAE. About 20 individuals expressed interest in being on the RAB. By spring of 1995, a community co-chair had been selected by the community members of the RAB, by-laws had been written, and the RAB was meeting on a regular basis.

Since the inception of the RAB, general attendance at the meetings has declined. Only one of the original RAB members continues to attend the meetings. Attendance is usually about 15 people with about 10 of the people representing the Navy or regulatory community. Meetings are held on an as-needed basis.

Information on the Technical Assistance for Public Participation (TAPP) grants program was provided to community members at the April 1998 RAB meeting. There has been no interest expressed in obtaining a TAPP grant.

Four workshops were held to obtain input from the regulatory and resource agencies regarding preferred cleanup approaches. Three workshops were held between November 1998 and January 1999 to review alternative sediment cleanup technologies, identify criteria for assessing the acceptability of alternate approaches, and develop an appropriate set of cleanup alternatives, The fourth workshop was held in December 1999 to present and discuss the cleanup approach favored by the Navy, Ecology, and EPA.

The proposed plan for marine OU B, formally presenting the preferred sediment cleanup approach, was issued for public comment on March 13, 2000. The public comment period extended through April 17, 2000.

A public meeting to present the proposed plan was held in conjunction with an open house on March 22, 2000. A notice of availability was published in the Bremerton Sun on March 17 and 22, 2000. About 10 community members attended the open house, and about 8 community members attended the public meeting.

The draft final remedial investigation (RI) report and draft feasibility study (FS) for OU B, together with other significant documents, have been made available for public review at the following branches of the Kitsap County Regional Library:

Central Branch
1301 Sylvan Way
Bremerton, Washington

Rev. Martin Luther King, Jr., Branch
612 Fifth Avenue
Bremerton, Washington

Port Orchard Branch
87 Sidney Avenue
Port Orchard, Washington

The Administrative Record for OU B, including the remedial investigation report, feasibility study, and other documents forming the basis for this ROD, are available for public review by contacting:

Engineering Field Activity, Northwest
Naval Facilities Engineering Command
19917 Seventh Avenue Northeast
Poulsbo, Washington 98370-7570
(360) 396-0214

5.0 SCOPE AND ROLE OF MARINE OU B

5.1 RELATIONSHIP WITH OTHER OPERABLE UNITS

OU B is one of four operable units at the Bremerton Naval Complex. The operable units (A, B, C, and NSC) were established based on the Navy's command structure, geographic location, site history, and suspected contamination (see Figure 1- 2). OU B is comprised of both terrestrial and marine areas OU B includes all of the nearshore marine environment associated with the Complex extending east and west along the shorelines of OUs A., B, and NSC. The marine portion of OU B, as previously defined in Section 1, includes a limited marine area adjacent to OU A and at one time was considered part of OU A. The OU A ROD deferred cleanup of the marine area off of OU A to OU B. This ROD addresses the cleanup of that area. The terrestrial portion of OU B includes most of the numbered sites identified during the original investigations of the complex (see Figure 1-3). With the consensus of EPA and Ecology, only the marine portions of OU B and the nearshore environment of Sinclair Inlet are addressed in this ROD. Decision documents regarding the terrestrial portion of OU B are being prepared separately. Decision documents for OU A and OU NSC have been completed, and the remedies specified in the RODs for those sites are in place. OU C is still under study.

5.2 COORDINATION WITH NAVIGATIONAL DREDGING PROJECT

The Navy intends to accelerate the cleanup of the marine portions of OU B and address terrestrial OU B separately. The Navy, Ecology, and EPA concur that the marine cleanup plans must be resolved promptly to seize the opportunity to coordinate cleanup with navigational dredging planned at the Complex. Because of the nature of the navigation dredging and construction in support of home- port activities, the OU B sediment cleanup would be delayed for 3 years or more if the Navy could not combined these projects. The areas to be dredged as part of the CERCLA cleanup action and the navigational project are described in Section 12. The navigational project is expected to involve dredging approximately 370,000 cubic yards of marine sediment. This work will occur within the marine area adjacent to the Naval Complex. Specifics of the navigational dredging project are discussed in a separate design report for that project.

6.0 SUMMARY OF SITE CHARACTERISTICS

The following sections summarize the physical, chemical, and biological characteristics of marine OU B and the adjacent upland areas that potentially impact the site. This material has been drawn primarily from the following documents:

- *Draft Final Remedial Investigation Report, Operable Unit B, Puget Sound Naval Shipyard, Bremerton, Washington,* March 16, 1999.
- *Draft Feasibility Study Report, Operable Unit B, Bremerton Naval Complex, Bremerton, Washington,* April 1999.
- *Final Biological Assessment, NIMI7Z- Class Aircraft Carriers Homeporting and Maintenance Berth Improvements, Bremerton Naval Complex, Bremerton,* Washington, August 20, 1999.
- *Sinclair Inlet Existing Conditions Data Compilation,* January 13, 1999. This document is also referred to as the "Aquascape Plan."

- *A Sediment Trend Analysis (STA®) of Sinclair Inlet/Port Orchard,* September 1998.
- *Water Velocities and the Potential for the Movement of Bed Sediments in Sinclair Inlet of Puget Sound,* Washington, 1998.

In Section 6, all water depths are referenced to mean lower low water (MLLW) and all upland elevations are referenced to mean sea level (msl), unless otherwise noted.

6.1 PHYSICAL SETTING

6.1.1 Location

Marine OU B encompasses the area between OU A and Site 10 East along the shoreline of the Bremerton Naval Complex and extending approximately 1,500 feet outward into Sinclair Inlet, as described previously in Section 1 (Figure 1-2).

6.1.2 Shoreline Characteristics and Bathymetry

The shoreline of the Complex has been greatly modified from its original condition. Historically the area consisted of tidelands, marshes, and forests. The area was cleared and filled in several stages beginning in the late I 800s to accommodate Naval operations.

The upland topography ranges from relatively flat in areas near the water to steep hillsides and rolling uplands farther inland. The nearshore area ranges in elevation up to about 25 feet above msl. The upland portions of the Complex reach a maximum elevation of about 170 feet msl.

At present, the shoreline comprises an industrial waterfront that is armored with quay walls and riprap and developed with several large over- water structures. Along quay walls, water depth drops off more or less vertically to approximately 15 to 20 feet below MLLW. In riprapped areas, depths at the immediate shoreline are commonly less than 5 feet MLLW, but drop off quite steeply beyond this. Recent bathymetric survey data at the Complex reveal water depths generally ranging between 40 and 45 feet, except in dredged areas near piers and vessel berthing areas where depths increase to 45 to 50 feet. Offshore of the site, water depths are generally 40 to 45 feet. Depths increase to over 50 feet in two bathymetric depressions located south of the Complex in central Sinclair Inlet.

6.1.3 Climate

The site experiences a cool, maritime climate because of its proximity to the Pacific Ocean and Puget Sound. The region is characterized by mild summers and winters, small diurnal ranges in temperature, considerable cloud cover, and abundant rainfall during much of the year. There is a high frequency of polar storm systems because of its middle- latitude location; these storms are strongest and most common during the winter months. Annual precipitation averages about 50 inches; average maximum precipitation occurs in December (over 8 inches), and minimum precipitation occurs in July (less than 1 inch). The annual average temperature is 51˚ F. Daily mean high and low temperatures for January are 45˚ F and 34˚ F, respectively; daily mean high and low temperatures for August are 75˚ F and 54˚ F, respectively.

6.2 CULTURAL RESOURCES

Sinclair Inlet is part of the Suquamish Tribe’s usual and accustomed fishing area, as defined by treaty and confirmed by the Boldt Decision. As such, the area has both cultural and commercial significance. Historically, the Suquamish Tribe has depended on fish and shellfish for subsistence. Salmon was the Tribe’s primary staple food; other species, including cod, smelt, herring, clams, oysters, and moon snails, supplemented salmon in their diet. Sinclair Inlet was an important source of seafood for the Suquamish. It is thought that the Suquamish had winter habitation in the area, such as a longhouse at what is now the city of Port Orchard, and set up seasonal fishing camps in areas such as Sinclair Inlet where food resources were seasonally abundant.

6.3 BIOLOGICAL RESOURCES

6.3.1 Shellfish and Other Invertebrates

Shellfish resources within Sinclair Inlet include both hardshelled clam and oyster beds. Clam species likely include butter clams, gaper clams, littleneck clams, and cockles. Geoducks have also been reported in Sinclair Inlet, Mussels found within Sinclair Inlet include the northern horse mussel and bay mussels.

Crabs of the genus *Cancer*, including Dungeness crabs, graceful crabs, and red rock crabs, commonly occur within Sinclair Inlet. Other crab species observed in the inlet include decorator crabs, kelp crabs, snow crabs, porcelain crabs, and pea crabs.

6.3.2 Marine Finfish

Sinclair Inlet provides habitat for a variety of bottomfish such as flatfish (soles and flounders), sculpins, poachers, eelpouts, greenlings, rockfish, and sharks and skates. Also occurring in the inlet are fish more typical of the water column, such as smelt, herring, perch, and sand lance. As part of the Puget Sound Ambient Monitoring Program (PSAMP), the Washington Department of Fish and Wildlife (WDFW) has been sampling fish in Sinclair Inlet since 1989, using both bottom trawls and midwater trawls in the central part of the inlet. The most abundant species found in these samples included English sole, Rock sole, Starry flounder, Pacific tomcod, shiner perch, pile perch, and Pacific herring.

Areas of the south shore of Sinclair Inlet (Ross Point and areas around Port Orchard) are known to be used for spawning by surf smelt and sand lance. There is one report of historical spawning along the north shore, but armoring and deepening along this shoreline has created a different habitat from that which existed historically and likely removed suitable spawning gravel.

6.3.3 Pacific Salmon and Sea-Run Trout

Five species of Pacific salmon and sea-run trout have been documented in the freshwater and marine habitats of Sinclair Inlet. These include chinook salmon, coho salmon, chum salmon, steelhead trout, and cutthroat trout. Sockeye salmon occur in Sinclair Inlet sporadically in low numbers. The occurrence of Puget Sound chinook salmon in Sinclair Inlet is described below in Section 6.4.

The use of Sinclair Inlet by salmonids is believed to be predominantly as a migration corridor. However, some rearing and forage by juvenile salmonids (e.g., chum, chinook, coho, and cutthroat) is probable. Juvenile out- migrants are presumed to use shallow areas along the north and south shores. The principal juvenile out-migration season is March through June. In-migrating adult chinook salmon use deeper areas of the inlet prior to moving into the tributary creeks to spawn.

Coho Salmon

Coho salmon are smaller than chinook, generally weighing between 3 and 12 pounds as adults. They typically spend a year or more in fresh water before migrating to the sea. The use of estuaries by juvenile coho for rearing is less important than for chinook, probably because coho are larger when they enter the estuary. Coho primarily use estuaries as migration corridors to the marine environment. Puget Sound coho salmon are currently listed as a candidate species under the Endangered Species Act (ESA).

Coho salmon spawning and rearing are documented in all significant tributaries of Sinclair Inlet. Sinclair Inlet coho are currently assigned “candidate” status for listing under the ESA by the National Marine Fisheries Service (NMFS). The terminal run for these coho typically runs from late August through mid- October. Adult river/ stream entry begins in early September and lasts until mid-November, with spawning commencing in late October and lasting through late December.

Chum Salmon

Chum salmon adults are similar in size to coho salmon, with an average weight of 7 to 12 pounds. Juvenile chum salmon spend a limited amount of time in fresh water before migration to estuarine and marine habitats (generally less than one week). Therefore the abundance and quality of suitable spawning habitat determine the productivity and survival of chum salmon in the freshwater phases of their life cycle. Suitable spawning habitats are areas of well-oxygenated, often groundwater- fed gravel substrate.

Chum salmon are currently rated as healthy by NMFS, with no protection under the ESA warranted at this time. Sinclair Inlet chum are divided into two distinct stock groups on the basis of run timing:

summer-run chum salmon and fall- and winter-run chum salmon.

Summer-run chum salmon in the inlet are identified as a unique stock on the basis of distinct genetic characteristics and geographic and temporal separation from other chum stocks in Puget Sound. This stock is of native origin, totally supported by wild production and is a focus of management interest at the tribal, state, and local levels. The terminal run period for summer chum is from late September through October. River entry runs through the month of October, with spawning occurring from mid-October to mid- November.

Fall- and winter-run chum salmon spawning in Sinclair Inlet tributaries are grouped together into a distinct stock on the basis of geographic isolation from other Puget Sound stocks and temporal isolation (different run timing) from the earlier spawning Liberty Bay/ Dyes and Sinclair Inlets stock. This stock is of native origin and is currently supported by composite hatchery and wild production. The terminal run for Sinclair Inlet fall chum begins in mid- November and lasts through December. River entry begins in early December, lasting through mid- January. Spawning runs from immediately after first river entry through late January.

Cutthroat Trout

The life history of cutthroat trout is different from salmon in that they are repeat spawners. Adults weigh between I and 6 pounds. Spawning occurs in late winter or spring and usually takes place in the isolated headwaters of their home stream in tributaries smaller than that used by coho and steelhead. These headwaters are also used for rearing for 3 to 4 years before downstream migration. They usually spend a year or less in marine waters before returning to their natal stream. In Puget Sound they generally migrate along beaches staying close to the coastline in water less than 3 meters (10 feet) deep.

Cutthroat trout are prevalent throughout the small and large tributaries of Puget Sound. Limited information exists for cutthroat trout in Sinclair Inlet. Puget Sound cutthroat trout are currently a candidate species under the ESA. A status review conducted by the NMFS concluded that very little is known about the population structure and habits of this species in general, but that listing under the ESA was not warranted.

Steelhead Trout

Puget Sound winter steelhead may rear for 2 or more years in fresh water before migrating to estuarine and marine waters. Therefore, survival and productivity through freshwater life-history stages is limited by the quantity and quality of suitable spawning habitat and the availability of suitable summer- and winter-rearing habitats and forage. In contrast to juvenile coho and chinook salmon, juvenile steelhead tend to prefer riffle areas. Winter- rearing habitat requirements are similar to those for coho, which are off-channel, low-current areas that provide refuge from high-flow events.

All steelhead in Sinclair Inlet are winter-run fish and considered to be generally healthy by NMFS. However, the high level of hatchery production in Puget Sound, pervasive habitat degradation, and the presence of several key stocks of concern have resulted in candidate status for listing under the ESA. Terminal- run timing for East Kitsap winter steelhead is not well known. River entry begins in early December, lasting until mid-March. Spawning occurs from late January through early April.

6.3.4 Waterfowl and Raptors

PSAMP aerial surveys during the summer of 1996 and winter of1997 indicated higher densities of bird species within Sinclair Inlet during the winter than in the summer. The highest densities of birds during the summer surveys tended to be associated with estuarine wetland (tideflat) habitats at the western end of the inlet and near Port Orchard. These areas also had dense populations of bird species in the winter, although the birds were more widely distributed.

Abundant waterfowl species include greater scaups, lesser scaups, ring-necked ducks, surf scoters, white-winged scoters, American wigeons, Canada geese, mallards, common goldeneye, mergansers, and bufflehead. Other species that were abundant during these surveys included – western grebes, double-crested cormorants, Pacific loons, American coots, and pigeon guillemots. Pigeon guillemots have been known to breed in the vicinity of the Complex.

Although several gull species occur within Sinclair Inlet, Glaucous-winged gulls were the most common gulls observed during Kitsap Audubon Society birds counts, and are abundant along the waterfront areas of the Complex. Mew gulls were also common. Shorebirds observed during the Audubon Society surveys include sandpipers, dunlins, and snipe. These waders are generally present in the tidal mudflats or along the sandy shoreline. Bald eagles, osprey, and great blue herons occur in Sinclair Inlet and have nests in the vicinity. Marbled murrelets have also been observed in Sinclair Inlet.

6.3.5 Marine Mammals

Marine mammals that are found within Puget Sound include the Pacific harbor seal, California sea lion, Steller sea lion, orca, gray whales, Dali’s porpoise, and harbor porpoise. These species likely occur within Sinclair Inlet. The whales are not known to breed and rarely feed in or near Sinclair Inlet. However, during 1996 and 1997, a gray whale and 19 orcas were observed feeding near the inlet.

6.4 ENDANGERED OR THREATENED SPECIES

In December 1998, the Navy requested that NMFS and the U. S. Fish and Wildlife Service (USFWS) identify any threatened and endangered species that could potentially be affected by a proposed dredging project in and near the marine portion of OU B. In January 1999, the agencies identified the following endangered or threatened species:

- Bull trout: threatened
- Chinook salmon: threatened
- Bald eagle: threatened
- Steller sea lion: threatened
- Humpback whale: endangered
- Leatherback sea turtle: endangered
- Marbled murrelet: threatened

The agencies also identified the following candidate species and “species of concern”:

- Puget Sound coho salmon: candidate for protection under ESA
- Long-eared myotis: species of concern
- Long-legged myotis: species of concern
- Pacific lamprey: species of concern
- Pacific Townsend’s big-eared bat: species of concern
- River lamprey: species of concern

Of these species only chinook salmon, coho salmon, and bald eagles are likely to be found in the area of the Naval Complex. Coho salmon are discussed above; chinook salmon and bald eagles are discussed in the following sections.

6.4.1 Chinook Salmon

There are no native runs of chinook salmon in streams draining to Puget Sound from the east side of the Kitsap Peninsula, including Sinclair Inlet and tributaries. Fall-run chinook in Sinclair Inlet are supported entirely by hatchery production of chinook in the Gorst Creek hatchery operated by the Suquamish Tribe in cooperation with the Poggie Club and City of Bremerton. The hatchery has been in operation since 1982 and currently releases over 2 million juvenile chinook into Gorst Creek annually. Wild spawning chinook salmon presumed to be of hatchery origin have also been observed in several inlet tributaries. In addition, wild chinook from stocks that spawn elsewhere in the Puget Sound Basin may occur in Sinclair Inlet on occasion during migration or other movements. The Suquamish Tribe reports that approximately 3 percent of the adult chinook caught annually in the tribal fishery in Sinclair Inlet and adjacent waters consists of fish from hatcheries other than the Gorst. Therefore, it is possible that native chinook from other stocks also occur in Sinclair Inlet. In 1998 the WDFW closed the chinook sport fishery in Sinclair Inlet and adjacent waters because of concerns that the fishery could intercept native chinook salmon returning to other Puget Sound streams. Based on these adult occurrence patterns, it is also possible that native juvenile chinook from other streams occur in Sinclair Inlet during their migration.

The practice of the tribal hatchery on Gorst Creek is to rear juveniles to smolt stage before release for downstream out-migration. Adults typically begin their terminal run in late July, continuing through to late September. Spawning takes place from late August to late October.

The use of Sinclair Inlet itself by chinook and other salmon is believed to be predominantly as a migration corridor. However, some rearing and foraging by juvenile salmon is probable. Juvenile out-migrants are presumed to use shallow areas along the north and south shores. Juvenile salmon were found during beach seining in relatively shallow areas at the southwest end of the Complex in May 1998. Chinook were the primary species collected, but chum, coho, sockeye, and steelhead trout were also found. There are no other data on the seasonal presence of juvenile salmon at the Complex. Juvenile chinook are typically released from the Gorst Creek hatchery throughout the month of May. The principal juvenile salmon migration season is presumed to be March through June. The deeper nearshore areas on these shorelines, such as are found at the Complex and to a lesser extent at marinas and other areas along the Port Orchard shoreline, may impede the migration of juvenile salmon.

In- migrating adult salmon use deeper areas of the inlet prior to moving into the tributary creeks to spawn. Traditional Suquamish Tribal knowledge suggests chinook in particular congregate in bathymetric depressions in Sinclair Inlet during their terminal run.

6.4.2 Bald Eagles

Adult, subadult, and juvenile bald eagles have been observed foraging within Sinclair Inlet. There have been recurring sightings in the vicinity of the Complex, although it is unlikely that they feed near the Complex on a regular basis because of the high level of human activity and variable prey availability. No perching and roosting trees are located near the Complex waterfront, although bald eagles have been observed perched on the masts of ships on occasion. No detailed surveys on perching sites around Sinclair Inlet have been conducted.

Bald eagles breed in the vicinity of Sinclair Inlet. The nearest active bald eagle nest is approximately 3 miles southwest of Pier D. Two bald eagle nests are located on the south side of the inlet. There are also three bald eagle nests to the north of Sinclair Inlet near Kitsap Lake and Dyes Inlet. These eagles likely forage within Sinclair Inlet. Other nests near Sinclair Inlet are located near Port Orchard Inlet, Rich Passage, and on Blake Island. In addition to the eagles that are residents or breed in the area, wintering eagles also forage within Sinclair Inlet. Wintering eagles would be present from late October to late March.

6.5 MARINE SURFACE WATER

Ecology classifies the marine surface waters of Sinclair Inlet west of longitude 122° 37W as “Class A.” The inlet is currently listed as degraded under Section 303(d) of the Clean Water Act (CWA). The listing is, in part, due to several chemicals detected in sediment above the State sediment quality criteria and in tissue above the National Toxic Rule criteria. The parameters of concern include several inorganics (arsenic, cadmium, copper, lead, mercury, and zinc), pesticides (aldrin and dieldrin), PCBs, and several organics (1,4-dichlorobenzene, 2,4-dimethylphenol, benz(a) anthracene, benzo(ghi) perylene, benzoic acid, bis(2-ethylhexyl) phthalate, butylbenzylphthalate, chrysene, fluoranthene, indeno(1 ,2,3-cd) pyrene, and phenanthrene). In general, dissolved oxygen (DO) concentrations in Sinclair Inlet marine waters meet or exceed the Class A water standard. However, Sinclair Inlet does exhibit isolated events of low DO concentrations, mostly in the inner part of the inlet, associated with unusually high phytoplankton and nutrient concentrations. Temperature, turbidity, and pH levels also generally meet Class A standards; however, occasional elevated temperatures and pH values have been recorded, apparently unrelated to human activities.

Surface water temperatures in Sinclair Inlet generally range from 46° Fin the winter to approximately 610 F in the summer and can vary widely under the influence of periodic storm events. Temperature and salinity profiles measured in 1994 indicate that the waters of Sinclair Inlet are weakly stratified with little variation. Stratification in Sinclair Inlet is regulated by freshwater input from the primary tributaries.

Sinclair Inlet is affected by multiple point and non-point pollution sources including wastewater treatment plant effluent, septic tank drainfields, stormwater runoff, and combined sewer overflows. Fecal coliform (FC) levels above Washington State marine water Class A criteria have been reported at multiple stations in Sinclair Inlet in conjunction with multiple sources. For example, a 1988 study reported elevated FC levels near the Bremerton wastewater treatment plant and at 4 of 10 sampling stations near the Complex. Data from 1992 and 1996 to 1998, taken at water quality stations along the south shore of the inlet, exhibited FC levels above State standards.

6.6 SEDIMENTS AND SEDIMENTATION

The Navy has arranged for several recent studies of conditions in the marine environment in the vicinity of the Naval Complex. During 1994 and 1995 the U. S. Geological Survey (USGS) collected extensive data on marine currents, providing useful insights on prevailing current velocity ranges and directional trends. In a 1998 companion study, GeoSea Consulting studied the nature of existing shallow marine sediments. In this study almost 400 sediment samples were collected and analyzed for grain- size distribution. Trends in the measured grain sizes were then evaluated to identify patterns of net sediment transport and provide evidence as to where sediment deposition or erosion appears to have predominated historically. The primary results of these studies and others conducted in the Sinclair Inlet area are summarized below.

Nearshore sediments along the north shore of Sinclair Inlet and in the central inlet are dominated by silt and clay, while those along the south shore are predominantly sandy. Coarser sediments are only present in intertidal areas affected by significant wave action (e.g., Ross Point). The implications of the depositional nature of the inlet are for contaminated sediments to remain resident in the inlet for long periods.

Tidal currents and winds are the primary sources of water circulation in Sinclair Inlet. Weak tidal currents move water in and out of the inlet with a maximum velocity of 0.2 to 0.3 knots. Analysis of tidal currents in 1994 indicated residual current speeds of less than 0.2 knots (10 cm/s) for more than 90 percent of the time, regardless of site location, water depth, or season. Residual current speeds higher than 0.2 knots were rare, and speeds higher than 0.4 knots occurred less than 0.5 percent of the time. Surface currents generally flow out of the inlet, although surface current flow into the inlet has been observed during summer months. Near-bottom currents primarily flow into the inlet, regardless of season. Currents are generally not capable of resuspending bottom sediments.

The USGS study indicated that flood-tide currents enter the inlet predominantly along the south shore, and that ebb currents flow mainly along the north shore. The dynamics of flood-tide currents flowing into Port Orchard and ebb-tide currents flowing out of Port Washington Narrows have the similar effect of returning outflowing water to the southern shoreline of Sinclair Inlet. This is consistent with the results of the GeoSea study, which noted the existence of a predominantly clockwise gyre in the inlet that tends to redeposit most suspended sediments in the inlet. This effect and the generally weak nature of these currents makes the inlet more depositional than erosional for both mud (silt and clay) and sand-sized particles. Existing sedimentation rates are 0.5 to 2 centimeters per year. Statistically significant trends have been noted for both sediment deposition and erosion within the Complex. The deposition of sediments at the Complex is a function of the circulation pattern of the inlet. The erosional trend in the northeast end of OU B indicates a separate source of sediment resuspension, likely associated with the higher water velocities common in Port Washington Narrows, adjacent to the northeast end of the Complex, and possibly also with propeller wash from Naval vessels and State ferries. Sediments picked up from the sea floor in this part of OU B may eventually redeposit within the inlet, or they may enter the higher- energy environment to the east and be transported away from the inlet.

The prevalent southwesterly winds push surface waters out of the inlet, bringing deep water to the surface for replacement. Observations during the winter and summer of 1994 showed that winds having sustained speeds of 9 or 10 mph from the southwest generated near- surface and mid-level currents out of and into the inlet, respectively. Wave climate in the inlet is dictated by wind-generated waves and vessel wakes. Vessel traffic ranges from small recreational and commercial fishing vessels to occasional larger tug and Navy ship traffic. Wind action in Sinclair Inlet generally creates a wave-height range of 0.5 to 2.5 feet. Maximum wave heights are generated with winds from the southwest.

Total organic carbon (TOC) is an important characteristic of marine sediments, because of its influence on benthic habitat and bioavailability of organic compounds. Concentrations of TOC range from 0.5 to 7.9 percent within OUR, and 0.8 to 6.1 percent in the remainder of the inlet. These concentrations are within the range of TOC values found in other enclosed embayments in the Puget Sound region.

6.7 ADJACENT UPLAND AREAS

The Complex includes almost 400 buildings, 6 drydocks, and 14 piers and moorings. Most of the waterfront is made up of bulkheads, quay walls, and similar structural features. A few areas feature comparatively steep slopes typically covered with riprap.

The area occupied by the Naval Complex has been greatly modified from its original condition. Historically the area consisted of tidelands, marshes, and forests. The area was cleared and filled in several stages beginning in the late 1800s to accommodate Naval operations. Virtually the entire low- lying waterfront area at the Complex was formerly tideland. This waterfront area, which houses the industrial operations at the Complex, is new land constructed of soil and various fill materials. The topography currently involves flat land along the waterfront connecting via steep hillsides to a rolling upland area. The industrial waterfront ranges in elevation from sea level to 25 feet above mean sea level and is almost completely paved. The hillsides adjacent to the waterfront reach a maximum elevation of 170 feet. There are no streams on the Complex.

Groundwater at the Complex tends to flow from the higher hillside areas to Sinclair Inlet, passing through the soil and fill that make up the lower waterfront area. Shallow groundwater beneath OU B is almost entirely intercepted by the drydocks before it can discharge to the inlet (Figure 6-1). Precipitation falling at the Complex is collected by an extensive system of stormdrains and discharged to the inlet. Seawater routinely intrudes into the soil and fill along the waterfront, mixing with groundwater. The amount of intrusion varies with the tide level, higher tides tending to cause more extensive intrusion.

6.8 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of the primary chemicals of interest (COIs) in marine OU B are summarized below, followed by a summary of the findings for the adjacent upland areas.

6.8.1 Marine Environment

Marine Sediment

The Washington State sediment management standards (SMS) are used to evaluate contaminated sediments. The long-term goal of the SMS is “to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from surface sediment contamination.”

To this end, the SMS include numerical standards for chemical and biological effects for the protection of marine animals living in the bottom sediments (the “benthic community”).

The SMS define two levels of chemical and biological criteria. The most stringent level, the sediment quality standard (SQS), corresponds to the long- term goal of” no adverse effects” on sediment biological resources, while the less stringent level, the cleanup screening level (CSL), corresponds to “minor adverse effects” on these resources. At contaminant levels above the CSL, more significant effects are predicted and a sediment cleanup decision is required.

The chemical criteria are based on Puget Sound data that indicate sediment chemical concentrations above which specific biological effects have always been observed in test sediments. Cleanup areas may be defined using chemical criteria alone. However, the SMS recognize that chemical data may not accurately predict biological effects for all sediment locations. Biological testing (bioassays and benthic evaluation), allowed under the SMS, can be conducted to determine whether biological effects predicted by the chemical concentrations are actually occurring. The biological testing must include two tests for acute toxicity to marine organisms and one for chronic biological effects. If all three biological criteria are met for a given area, this area is not included in the cleanup area and does not require cleanup under the SMS for protection of benthic organisms. Failure to meet the biological criteria confirms the potential for adverse impacts to the benthic community.

Surface and subsurface marine sediments were collected for investigation prior to and during the OU B RI to assess the nature and extent of contaminants. In addition, bioassays and benthic infauna analyses were conducted to directly measure the biological effects of the sediments on marine organisms.

Based on a comparison of sediment chemical results to the SQS and CSL criteria, the RI identified numerous semivolatile organic compounds (SVOCs), several inorganic compounds, and total polychlorinated biphenyls (PCB5) as chemicals of interest for marine surface sediment. Table 6-1 summarizes the results of analyses of inlet surface sediment samples for key chemicals.

Figure 6-2 presents the distribution of SQS exceedances for all analytes except mercury. Figure 6-3 presents the distribution of CSL exceedances for individual chemicals other than mercury. Elevated mercury levels are ubiquitous throughout the marine sediments of OU B (as well as OU A and central Sinclair Inlet). Mercury was detected in surface sediments at a frequency of97 percent; 88 percent of the locations exceeded the SQS, and 79 percent of the locations exceeded the CSL (Figure 6- 4). The highest concentrations and the greatest number of sampling locations with mercury CSL exceedances occur between OU A and Pier C and between Piers 3 and 7. The highest surface concentration of mercury, 5.2 mg/kg, was recorded at a nearshore location at OU A. The highest level of mercury found in Complex sediments was 12.3 mg/kg at a depth of 5 to 40cm in a nearshore location at OU A.

PCBs were detected in surface sediments at approximately half of the locations sampled within marine OU B through 1995. However, comparatively high detection limits for many of the historical sediment PCB analyses limit the usefulness of these historical PCB data. Concentrations of total PCBs exceeded the SQS value of 12 mg/ kg organic carbon (OC) at 12 locations within OU B and at I location outside OU B. The maximum summed concentration of the individual PCBs (total PCB5) within the Complex boundary was 54.8 mg/kg OC just west of Pier B; the maximum concentration of total PCBs in Sinclair Inlet was 74.2 mg/kg OC just outside the boundary. There were no exceedances at the Sinclair Inlet reference locations.

Because of the limitations to the historical sediment PCB analyses, additional sampling of sediments and analysis for PCBs was conducted in December 1998 to January 1999. This sampling was designed to provide a more accurate definition of the horizontal and vertical extent of PCBs in sediments and to estimate the PCB concentrations in sediments that are being transported into Sinclair Inlet. The primary purpose of this investigation was to provide the data needed to define areas requiring remedial action to support the development of the FS and remedial design. The results of the new data were reported in a technical memorandum in June 1999. Figure 6-5 summarizes the horizontal distribution of PCBs in surface sediments (0 to 10 cm). Figure 6-6 summarizes the vertical distribution of PCBs in the sediments. The implications of these results, in terms of defining the areas requiring remedial action, are discussed in Section 10.

Bioassays were performed on sediments from 34 Sinclair Inlet stations representing all of the habitat within the Complex boundaries, except for the extreme west end of the Complex at OU A. The bioassays consisted of two acute bioassays, one using Rhepoxynius or Ampelisca and the other using Dendraster, and a chronic bioassay using Neanthes. The results showed that, in spite of the presence of several chemical contaminants, the sediments of Sinclair Inlet produce, at most, a minor adverse biological effect (i.e., an SQS exceedance) in laboratory test organisms. There were no adverse biological effects (i.e., a CSL exceedance) for any of the three test organisms at any of the stations. Only 15 locations showed even minor adverse effects. Only a limited correlation between biological effects and elevated chemical levels was found, and that correlation was actually negative. Biological effects were more likely to occur with samples from less contaminated locations.

A benthic infauna investigation was also performed at 12 locations to assess the community structure. These analyses suggest that conditions in Sinclair Inlet have a comparatively modest adverse effect on benthic invertebrates, although they demonstrate some impact or marine life, based on comparisons to reference locations in less developed areas.

Marine Tissue

A 90-day bioassay that involved suspending caged blue mussels approximately 1 meter above the floor of the inlet was performed for the marine habitat adjacent to the Complex. Blue mussels are resident filter feeders that bioaccumulate chemicals associated with particulate food matter. The caged mussel bioassay was designed for studying impacts of water- and sediment-borne chemicals on the marine ecosystem. Tissue samples from blue mussels in Sinclair Inlet and a reference area (Holmes Harbor) were analyzed for SVOCs, pesticides and Aroclors, organotins, inorganic compounds, and lipids content. Concentrations of 11 chemicals were found to be significantly elevated in mussels from Sinclair Inlet, with respect to the reference location. Aroclor 1254 was detected in the Sinclair Inlet mussels, but not in the reference mussels. Figure 6-7 shows the locations used in the caged mussel test. The laboratory results are summarized in tables included in Section 8.

Two groups of English sole were collected and analyzed (Figure 6-7). Fillet samples were taken from larger (older) fish and analyzed for SVOCs, pesticides and Aroclors, organotins, inorganics, and lipids content. Chemicals that were statistically elevated in English sole fillets from Sinclair Inlet, when compared to the reference area in Holmes Harbor, were one SVOC, seven pesticides, Aroclor 1260, and several inorganics. The whole-body tissues of a second group of younger English sole were also submitted for chemical analysis. The chemicals that were statistically elevated in whole- body

English sole from Sinclair Inlet when compared to the reference area were 1 SVOC, 10 pesticides, Aroclor 1260, and several inorganic compounds.

Livers from 60 of the individual English sole collected at each of the S sampling locations were collected and used for histopathology analysis. This analysis is intended to directly measure the frequency of occurrence of liver lesions believed to be indicative of contact with contaminated sediment. The measured frequency of liver lesions in sole from the inlet is considerably lower than reported for Eagle Harbor and the Elliott Bay-Duwamish Waterway area, two nearby industrialized sites. The lesion frequency in inlet sole was as low as or lower than frequencies reported for a number of rural Puget Sound area bays with no apparent sources of chemical contamination.

Sea cucumber tissues from Sinclair Inlet and a reference site were analyzed for SVOCs, pesticides and Aroclors, organotins, inorganic compounds, and lipid content. The chemicals that were statistically elevated in sea cucumbers from Sinclair Inlet, when compared to the reference areas, were five cPAHs, nine noncarcinogenic polycyclic aromatic hydrocarbons (PAHs), Aroclor 1254, six pesticides, and three inorganic compounds.

6.8.2 Adjacent Upland Areas

Volatile Organic Compounds

Only two volatile organic compounds (VOC5), tetrachloroethene or perchloroethene (PCE) and trichloroethene (TCE), exceeded screening levels and were identified as COIs in groundwater and drydock seep samples. PCE is also considered a COT in soil and catch- basin water samples; TCE is also considered a COT in drydock relief drainage samples. Exceedances were limited to the eastern area of the shipyard, primarily near Site 7. The most probable sources for PCE are past degreasing activities at the pipe and boiler shop (Building 107) and migration of chemicals from commercial drycleaners upgradient of the shipyard. TCE may also be attributable to shop practices at the former metal plating and treating facilities (e. g., Building 99), vehicle maintenance operations, activities at Building 107, or the chemical breakdown of PCE. No volatile organic COTs were identified in other media.

Semivolatile Organic Compounds

Most of the individual carcinogenic polycyclic aromatic hydrocarbons (cPA}{s), as well as total cPAHs, are considered COIs in all media except drydock water samples. Total cPA exceedances of screening criteria were documented near oil pipelines, in the eastern waterfront area (Site 10 East), at the former shipbuilding ways burn pit near Site 1, north of and between Drydocks 2 and 4 (near Site 7), between Drydocks 4 and 5 (near Site 10 Central), near Building 107 (near Site 7), near the closed Building 106 underground storage tanks (USTs) at Site 8, and at Site 10 West (see Figure 1-3). Probable sources of cPAHs include leaks from oil pipelines and USTs, historical coal pier remnants, former burn pit residuals, releases of waste oil during industrial activities, the landfill associated with the former town of Charleston, and the oil distribution facility at Site 10 West.

In addition to cPAHs, the semivolatiles acenaphthene, fluoranthene, 4-methylphenol, butylbenzylphthalate, phenol, PCP, and bis-2(ethylhexyl) phthalate (BEHP) are also considered COTs in at least one medium. Likely sources of most of these compounds include breakdown products from organic materials in industrial fill and former burn pits. Most exceedances were found near Site 10 Central. PCP is most likely attributable to preservative leaching from wood fragments reported in soil borings at Site 10 West. BEI-IP may be associated with plastic materials in fill as well as cross-contamination from plastic materials during sample collection and analysis.

Pesticides/Aroclors

Thirteen chlorinated pesticides and four PCBs are considered COIs in at least one medium. Soil and groundwater exceedances of screening criteria were located near the former burn pit at Site 10 Central and near Sites 1, 8, and 10 West. Pesticides were detected in all drydock water samples except those from Drydock 5, in catch basins near OU NSC, and at stormwater locations 006 and 030 in the eastern and central portions of the shipyard, respectively. No specific sources for pesticides have been identified, although some historical use of pesticides such as for vermin control seems likely.

No pattern of PCB detections has been established. Potential sources include a spill reported at Site 10 Central, historical storage of waste PCBs and off- line transformers at Site 2, a historical spill near Building 399 (the area was subsequently paved), and Aroclor 1268 used in sound-dampening felt in submarines.

Total Petroleum Hydrocarbons

The four total petroleum hydrocarbon (TPH) subsets total petroleum, diesel, motor oil, and gasoline are considered COIs. Three were detected in soil and groundwater, and all four were detected in catch basin sediments. TPH detections and source areas coincide with areas where total cPAHs were detected and are likely the result of the same sources cited for cPAHs above. Heavy vehicle traffic over formerly unpaved areas likely also has contributed to TPH detections.

Inorganic Compounds

Fourteen inorganic compounds are considered COIs in at least one medium. Arsenic, copper, lead, nickel, and zinc have been identified as COIs in all terrestrial media at all sites. Possible sources for these metals include the following:

- Spent abrasive grit and copper slag in fill
- Metal plating operations
- Foundry activities
- Equipment maintenance
- Use, maintenance, and stripping of lead-based paint on cranes
- Lead additives in petroleum products
- Materials storage at Building 399 and sheet metal work at Building 857
- Batteries
- Electronic equipment
- Storage of metals on unpaved surfaces

Beryllium, cadmium, mercury, and silver are COIs in at least three media. Beryllium exceedances of screening criteria were reported at all sites except Site 7. High concentrations of cadmium were found near Building 873, at Soil Boring 717 at Site 10 West, at monitoring well 412 at Site 10 Central, in Drydock 5, and in catch basins in all regions. Mercury exceedances of screening criteria were noted at all sites, Drydocks 1 and 4, and all but one catch basin. Soil and groundwater exceedances of silver screening criteria were noted at Sites 2, 10 East, and 10 West. In addition, silver exceedances of screening criteria in both soil and catch basin sediment samples were also documented at Sites 1, 7, and 10 Central and in Catch Basin 003/ 004 near Site 8. No potential sources of beryllium have been identified. The most likely sources for inorganics are batteries, electrical components, metal plating operations, breakage of mercury-bearing gauges, handling of mercury-bearing wastes, and sandblast grit in fill. Antimony, chromium, hexavalent chromium, cyanide, and thallium exceedances were documented in either one or two media. Antimony and chromium exceeded catch basin sediment screening criteria in the eastern portion of the shipyard; antimony exceedances were also noted at Catch Basins 030 in the center of the Complex and 037 at OU NSC. Hexavalent chromium and cyanide are considered COIs in soil. Analyses for hexavalent chromium and cyanide were only performed on samples collected near Building 873; therefore, exceedances are limited to that area. Total thallium and dissolved thallium are considered COIs in soil and groundwater, respectively. Thallium exceedances have been reported at all sites except Site 10 West. Potential sources of these inorganics include industrial fill materials, pipe and boiler shop operations, and plating operations.

Most of the highest recently measured groundwater levels of arsenic, copper, lead, mercury, and zinc have been associated with samples collected in the shoreline portion of the Complex in three areas: the shoreline shared by Site 10 West and two sites west of OU NSC, Site 1, and Site 8. In each of these three areas, at least one of the highest reported near-surface soil concentrations of one or more of these five inorganics has also been found, indicating a potential for leaching into groundwater and transport in dissolved form.

6.9 FATE AND TRANSPORT OF COCS

The OU B RI report has suggested that the primary potential mechanisms of chemical transport from the upland areas of the site to marine OU B are groundwater movement and surface water discharges through the stormwater system.

Besides extensive fill placement, other aspects of development at the Complex have also substantially altered the natural groundwater regime. Very little rainwater infiltrates into the soil in the industrial waterfront area at the Complex, because this area is almost totally paved. Consequently, almost all groundwater passing through the fill materials at the Complex originates in the upland area. Under natural conditions this groundwater would tend to flow from the higher hillside areas to Sinclair Inlet, passing through the soils and fill materials that make up the waterfront. However, structural features of the Complex substantially alter this theoretical groundwater flow pattern. The six drydocks at the Complex are equipped with dewatering systems to counteract hydrostatic pressure, which would otherwise tend to float the drydocks out of the ground (see Figure 6-1). The dewatering systems actually pull most groundwater into the drydocks throughout most of the Complex. The interception of groundwater by the drydock dewatering systems is amplified because quay walls and bulkheads along much of the shoreline further restrict direct groundwater flow to the inlet. Only in limited areas, primarily at the west end of the Complex, does groundwater discharge directly to the inlet.

In addition to collecting groundwater the dewatering systems also increase the natural intrusion of seawater into the site. This seawater mixes with the groundwater so that what enters the dewatering systems is actually groundwater diluted with considerable seawater. Within the drydocks the mixed groundwater and seawater combines with any rainfall or other water collected by the drydock drainage system. Thus, the original groundwater is substantially diluted with seawater and drydock drainage water well before being discharged from the drydocks into Sinclair Inlet. The net result is that throughout most of the Complex groundwater passing through soils and fill and potentially picking up and transporting chemicals actually flows into the drydock dewatering systems, undergoing considerable dilution in the process. Chemical concentrations measured in drydock discharge water are routinely lower than the levels measured in groundwater samples from site monitoring wells; few exceedances of regulatory criteria by drydock discharge water have been observed during NPDES and CERCLA monitoring.

Since the draft final RI report was published, the Navy has performed a variety of analyses to assess the potential impacts on marine sediments of that fraction of site groundwater that discharges directly to the inlet, primarily in the west end of the Complex. The primary motive for this work has been to determine whether marine sediment remediation might be compromised in the fixture by ongoing groundwater discharges. A straightforward comparison of laboratory results shows that the chemicals of concern tend to occur at much higher concentrations in soil/fill and sediment than in groundwater. The ratios between the soil and groundwater concentrations typically range from about 1,000 to 1 to almost 400,000 to 1. Marine sediment concentrations are generally comparable to soil concentrations. While not wholly conclusive by itself, this observation suggests that chemicals found in marine sediment at marine OU B are more likely to be the result of releases of chemicals adsorbed to particulate materials derived from site soil and fill than from groundwater transport of dissolved chemicals. To check this hypothesis, the Navy modeled the likely impacts of continuing discharges of groundwater on marine sediments. The conclusion of the modeling was that it would be quite a long time, potentially thousands of years, before current groundwater discharges would cause chemical concentrations in clean sediment to reach the State SQS levels. The Navy, Ecology, and the EPA have concurred that the likelihood of recontamination of marine sediment by groundwater appears to be negligible, and groundwater conditions at the Complex today do not pose a significant threat to the marine environment.

The possibility that historical releases of chemicals adhering to particulate mailer may have contributed to marine sediment contamination reinforces concerns about the potential for stormwater systems to act to transport chemicals out of the terrestrial portion of the Complex. Surface water flowing across the land surface toward stormdrains can pick up chemicals both in association with particulate matter and in dissolved form. Stormwater that encounters debris accumulated within the stormdrain system can also suspend particles with sorbed chemicals and dissolve chemicals from the debris. Contaminated soil/fill and groundwater also can potentially enter the stormwater system through gaps or breaks in the stormwater lines. Considering that many of the lines are many decades old and have reportedly received very little maintenance, gaps and breaks in the lines may be quite common. Consequently, the stormwater system at the Complex appears to be the primary potential mechanism for chemicals to move from the terrestrial environment to marine OU B. The stormwater system will be addressed in the final ROD for OU B.

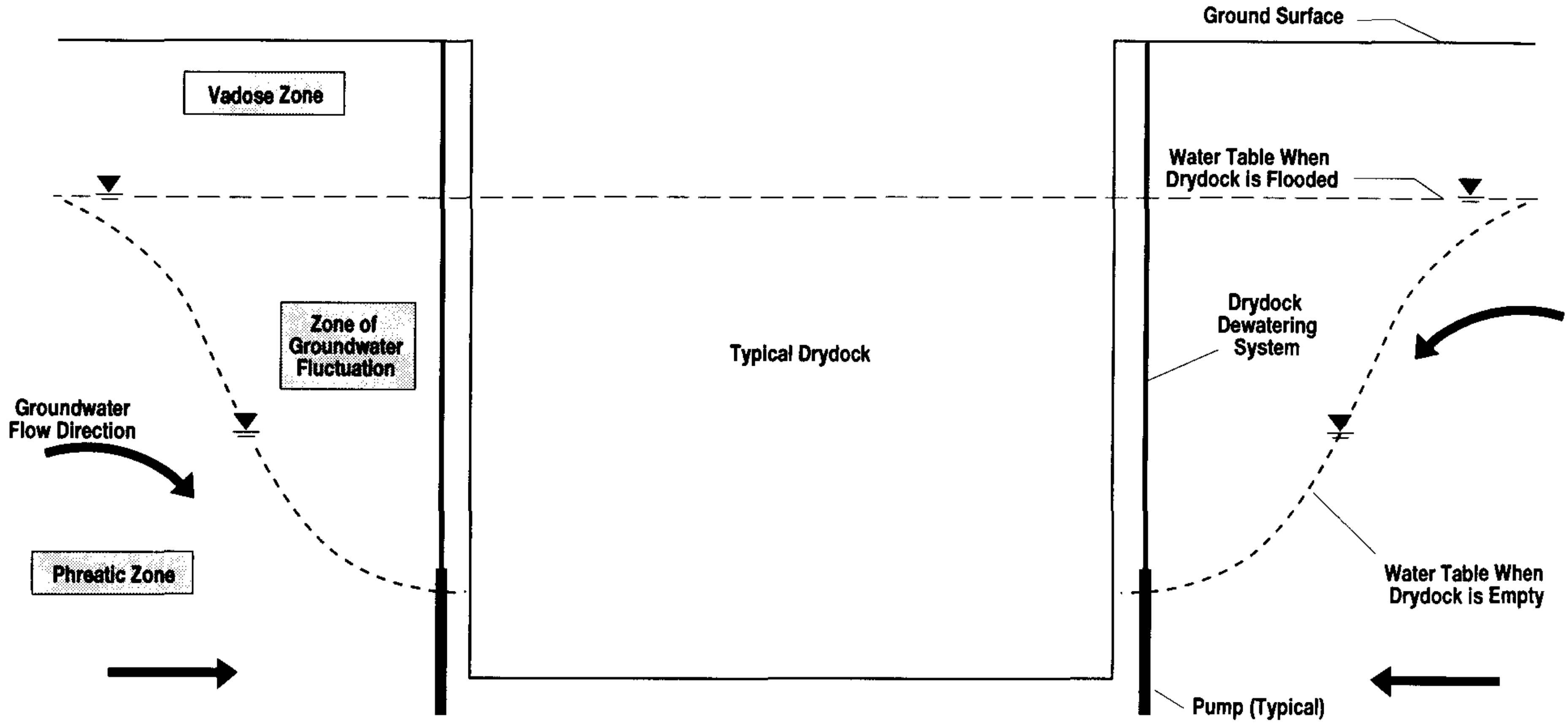
A secondary potential mechanism for chemicals from the terrestrial portions of the Complex to reach the marine environment is erosion or slumping of fill from those limited portions of the shoreline not protected with bulkheads or quay walls. Riprap along most of these shoreline areas likely acts to reduce potential erosion. However, recent investigations off of Site 1 (see Figure 1-3) suggest that there has been significant slumping of the steep fill slope into the inlet at this location.

Table 6-1
Summary of Concentrations of Key Chemicals Found in Sinclair Inlet Surface Sediments

Chemical	Minimum a	Maximum a	Washington State Sediment Quality Standards (SQS) a	Washington State Cleanup Screening Level (CSL) a
Total PCBs b	1.57	61.7	12	65
Total HPAHs c	0.27	4,640	960	5,300
Total LPAHs c	0.63	998	370	780
Arsenic	2.3	111	57	93
Copper	5.4	1,700	390	390
Lean	2.7	1,50	450	530
Zinc	23.9	7,390	410	960

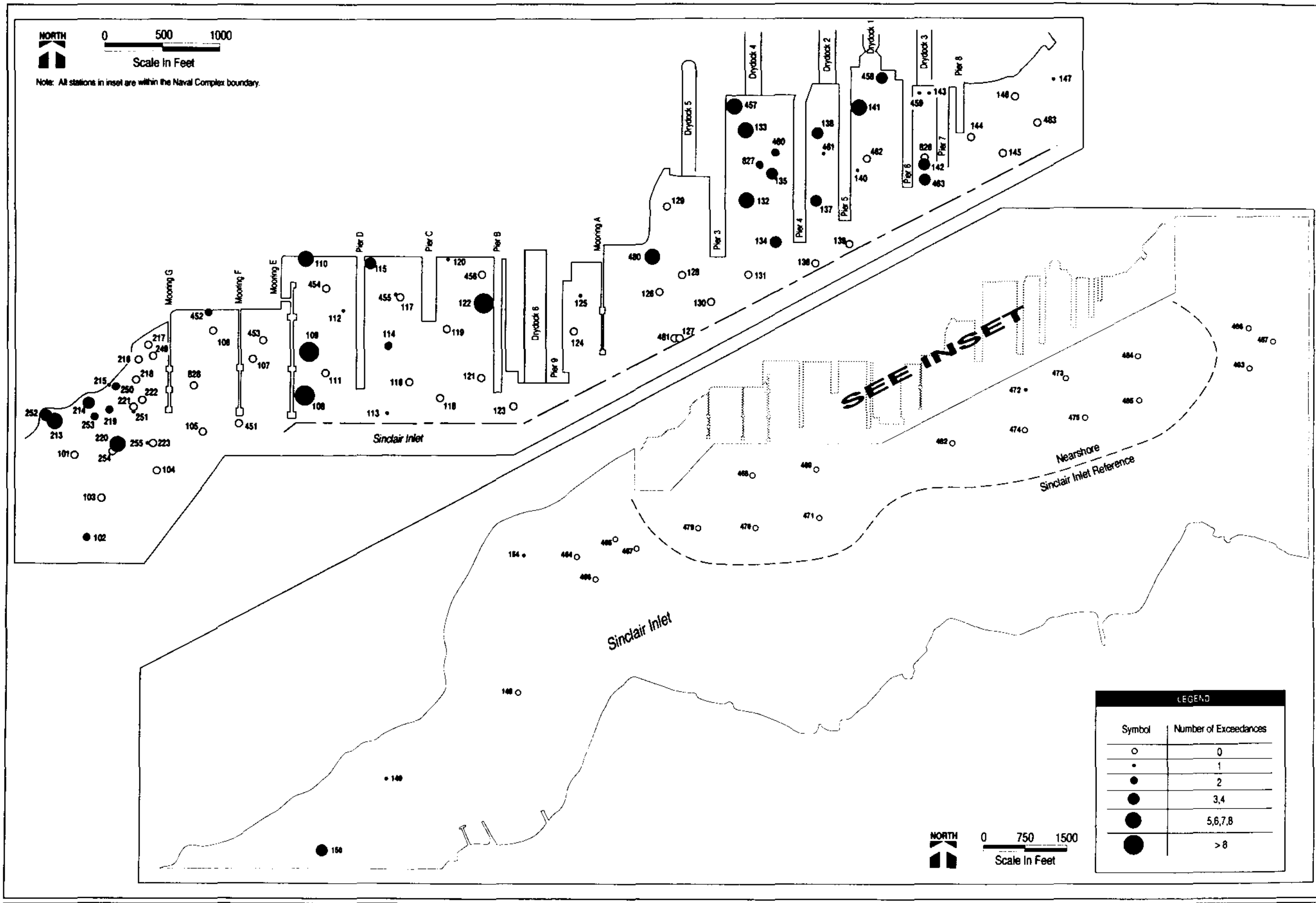
a All units of measure for total PCBs, total HPAHs, and total LPAHs are mg/kg of organic carbon and mg/kg for arsenic, copper, lead, and zinc.
b PCB results are from sampling in 1998 to 1999; results for other chemicals are from sampling between 1990 and 1996. PCB concentrations are normalized based on organic carbon.
c HPAH and LPAH as defined in Washington State Sediment Management Standards. PAH concentrations are normalized based on organic carbon.

Notes:
HPAH - high-molecular-weight polycyclic aromatic hydrocarbons
LPAH - low-molecular-weight polycyclic aromatic hydrocarbons
mg/kg - milligram per kilogram
PCBs - polychlorinated biphenyls



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-1 Conceptual Drydock Hydrology**	CTO 0131 OU B MARINE Bremerton, WA RECORD OF DECISION

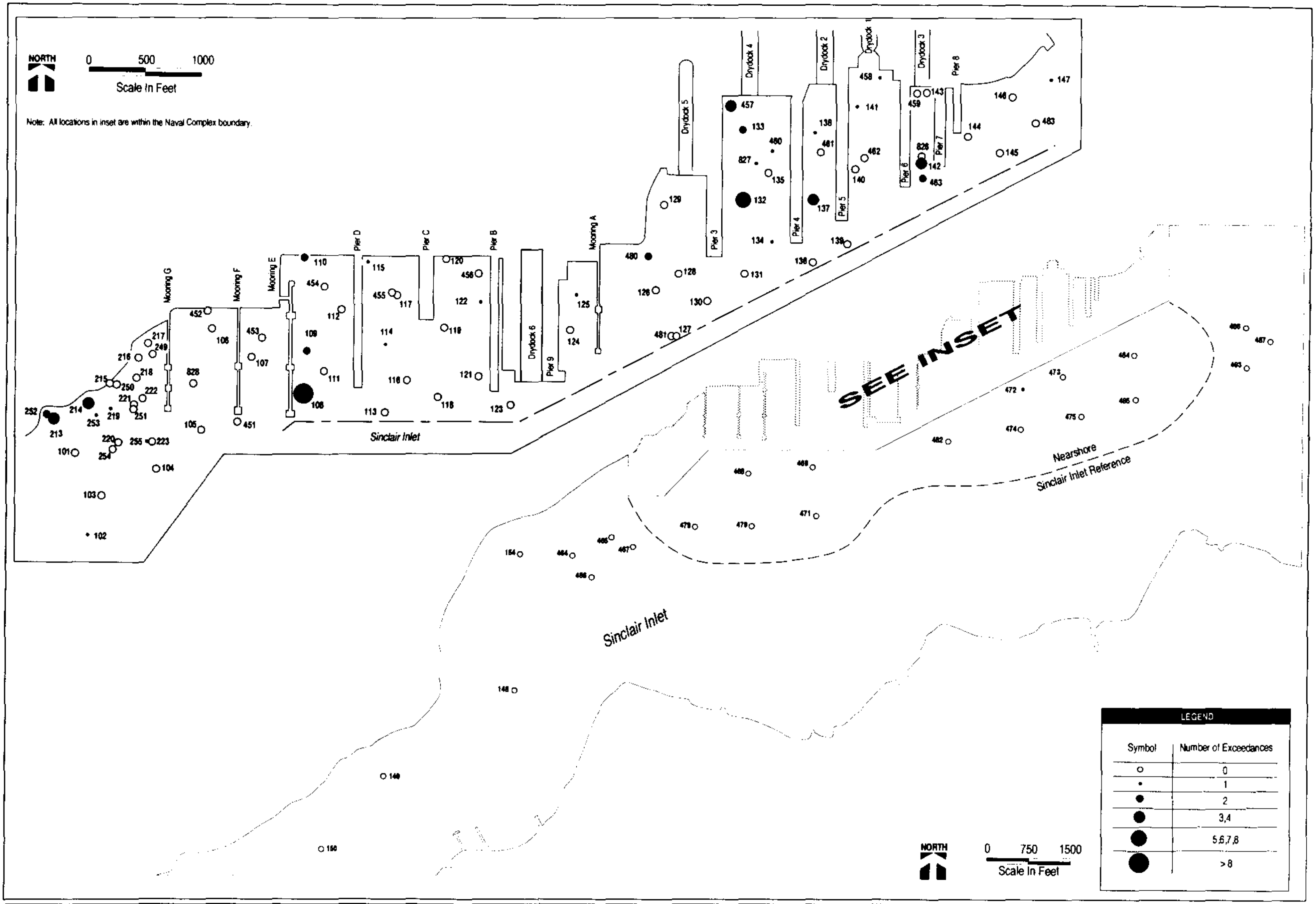
533131004-327-05100



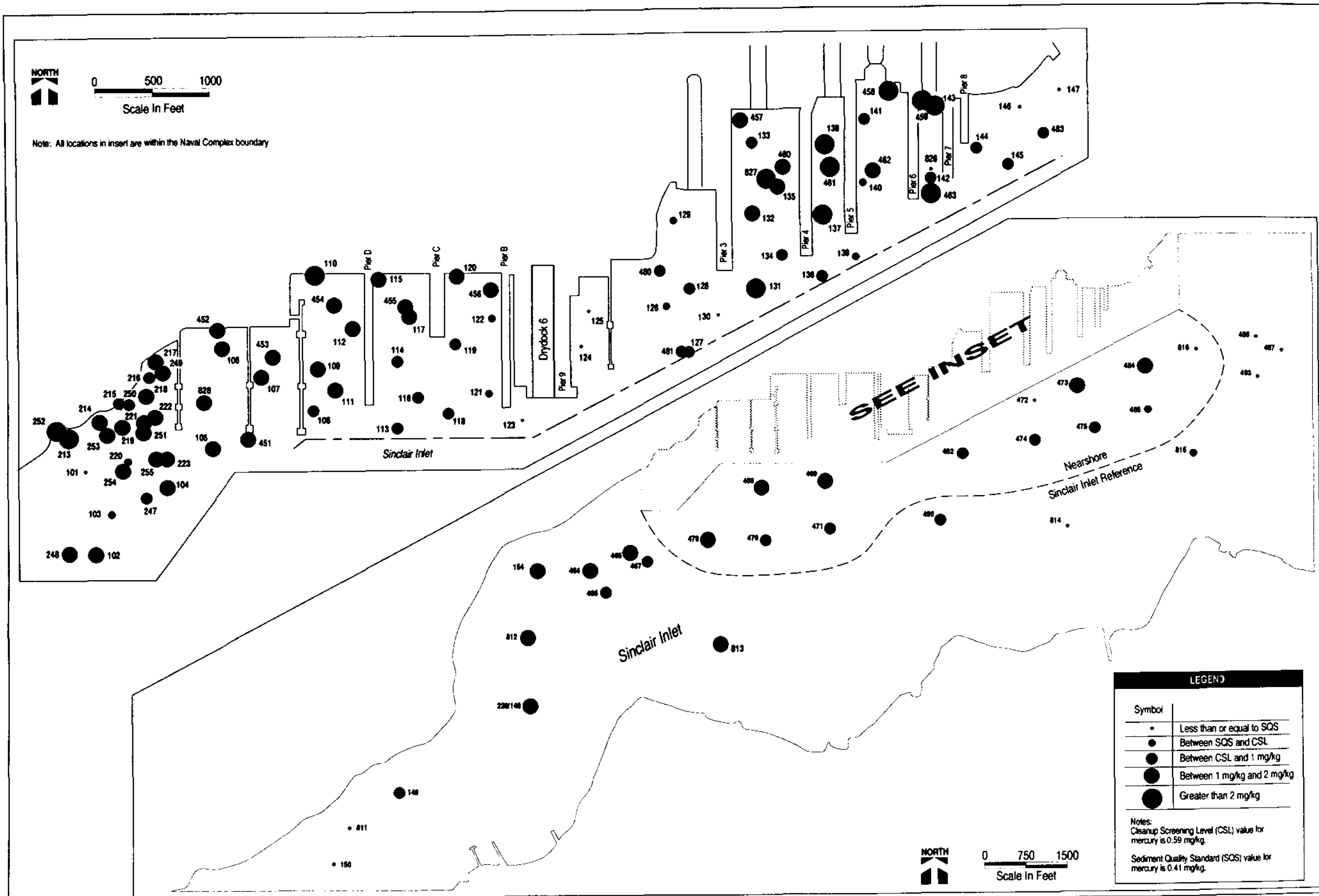
CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY
443-042299

Figure 6-2
Washington State Sediment Quality Standard Exceedances in Sinclair Inlet Marine Sediments (Excluding Mercury) 1990 to 1995

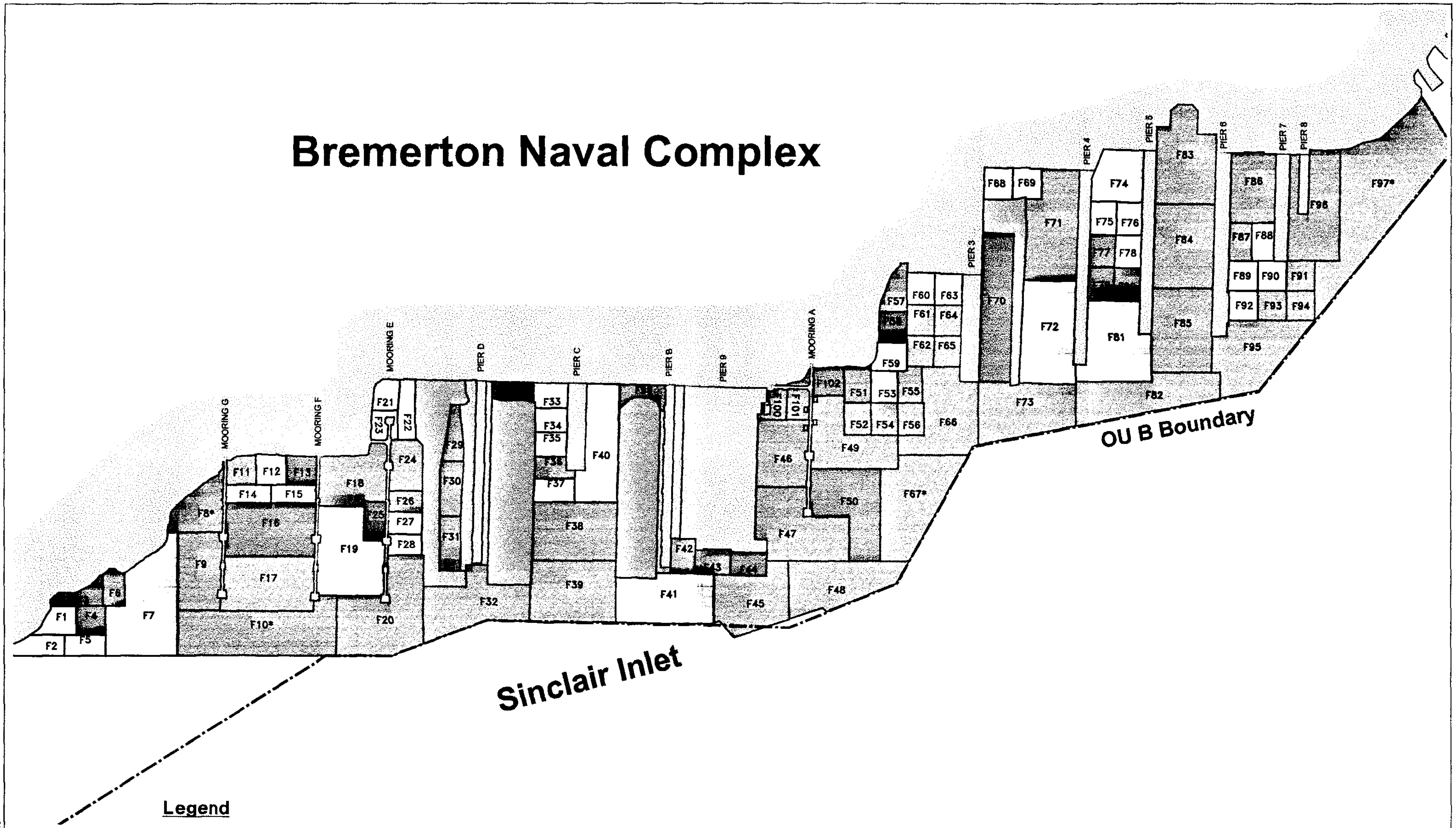
CTO 0131
OU B MARINE
Bremerton, WA
RECORD OF DECISION



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY 444-042299	**Figure 6-3** **Washington State Cleanup Screening Level Exceedances of Sinclair Inlet Marine Sediments (Excluding Mercury) 1990 to 1995**	CTO 0131 OU B MARINE Bremerton, WA RECORD OF DECISION



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY 442-042299	**Figure 6-4** **Mercury Concentrations in Sinclair Inlet Marine Sediments, 1990 to 1997**	CTO 0131 OU B MARINE Bremerton, WA RECORD OF DECISION



Legend

- < or = 6 mg/kg OC
- 6.01 to 12 mg/kg OC
- > 12 mg/kg OC
- F8* Data from RI Used to Characterize These Feasibility Study Sampling Units
- Shore, Moorings or Piers
- Areas Sampled for Navigational Dredging or Not Accessible
- F1 CERCLA Feasibility Study Sampling Unit
- Exclusion Zone Boundary

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	CTO 0131 OU B MARINE Bremerton, WA RECORD OF DECISION	0 150 300 600 SCALE IN FEET	Figure 6-5 Horizontal Distribution of PCBs in Surface Sediment at the Bremerton Naval Complex

FILENAME: T:\psns\CTO131\Sub-Tasks\Off-Shore\Reports\ROD\RD-6.dwg
EDIT DATE: 06/01/00 AT: 13:18

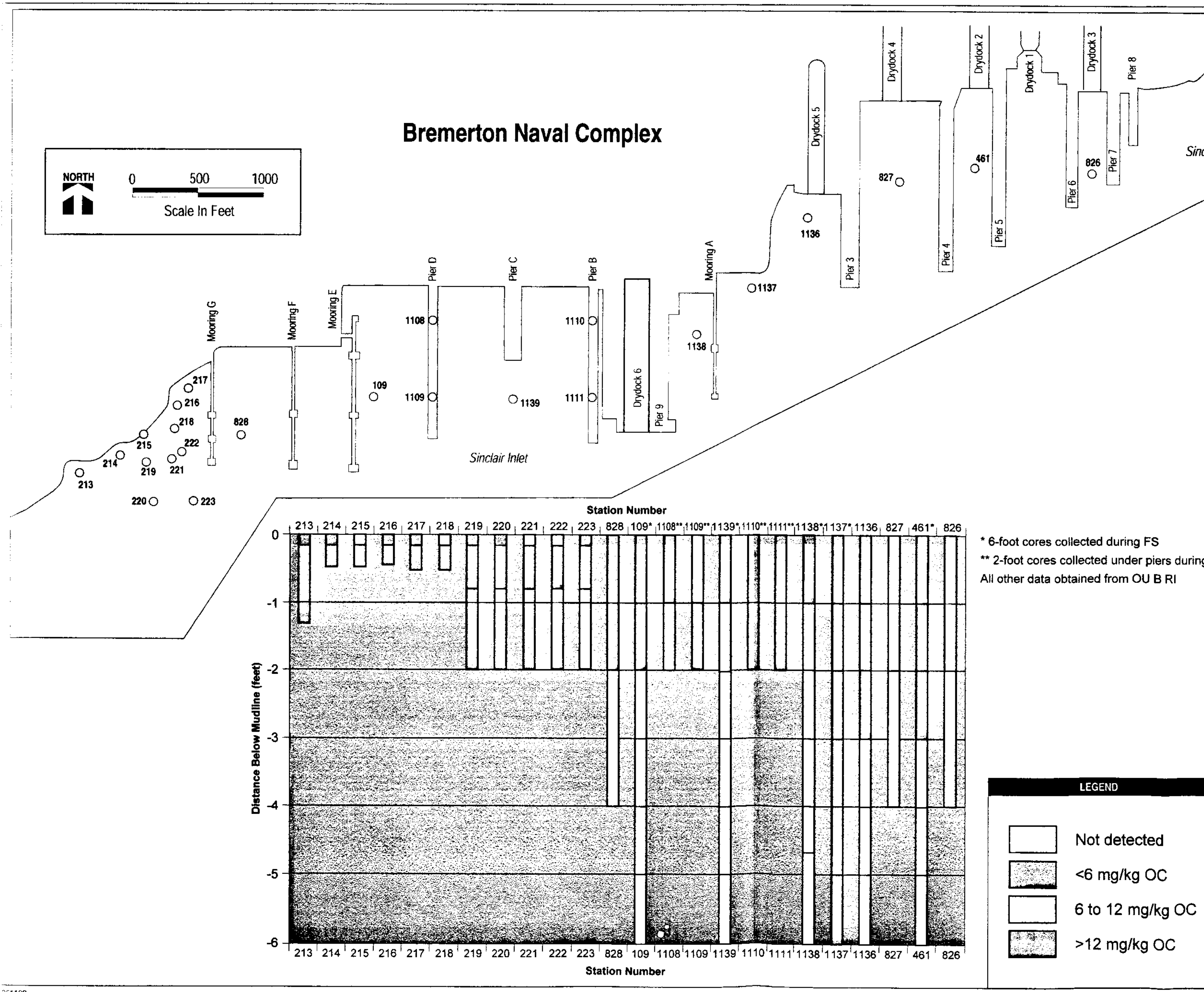
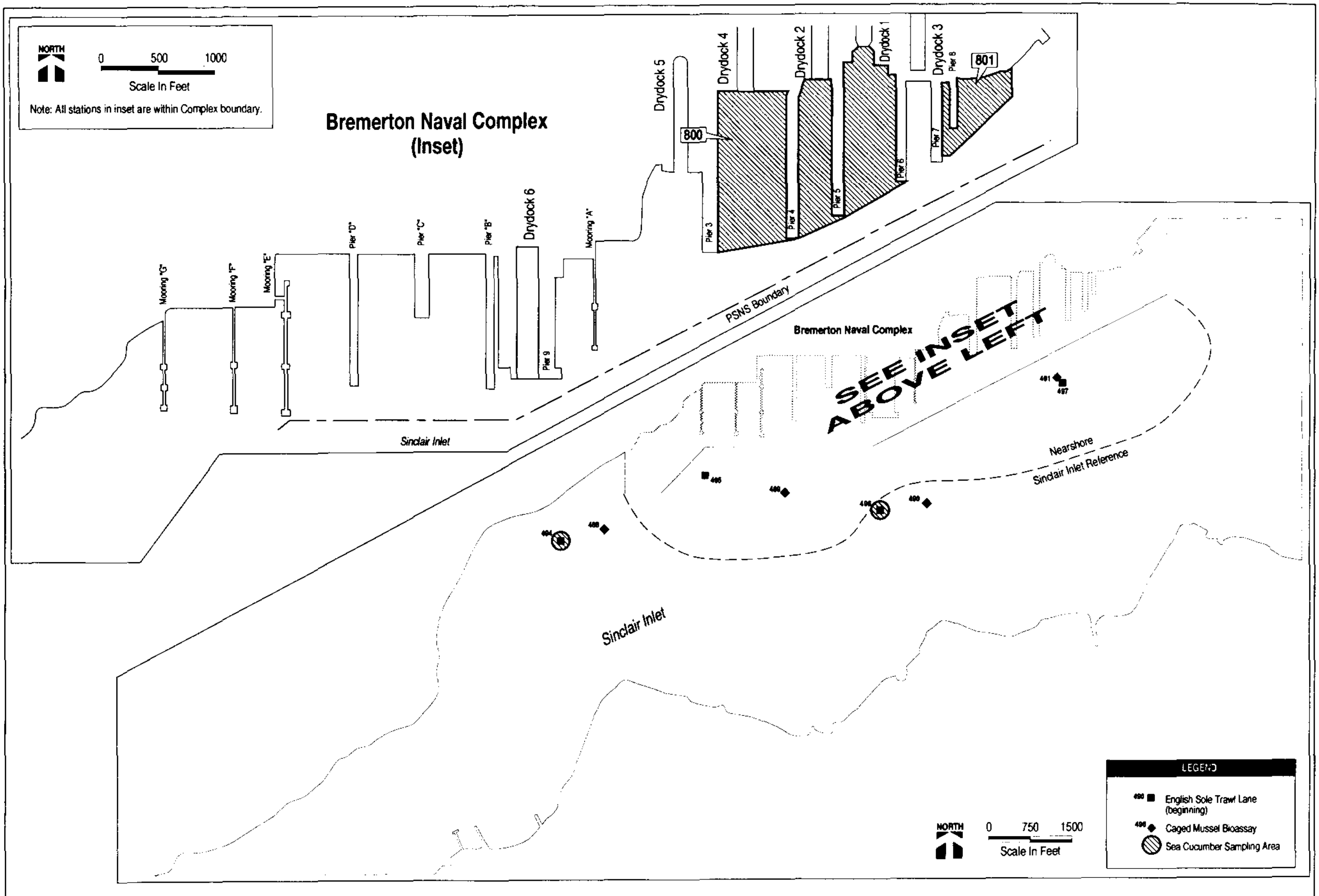


Figure 6-6
Vertical Distribution of PCBs at the Bremerton Naval Complex

NORTH
0 750 1500
Scale In Feet

CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

CTO 0131
OU B MARINE
Bremerton, WA
RECORD OF DECISION



CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY
533131004-202-121498

Figure 6-7
OU B Marine Tissue Sampling Locations

CTO 0131
OU B MARINE
Bremerton, WA
RECORD OF DECISION

7.0 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

7.1 SITE USES

The Naval Complex is situated along the south edge of the City of Bremerton; the City has limited jurisdiction over land-use decisions. Most land use at the Complex would be consistent with heavy industrial land- use categories of the City of Bremerton. Six large drydocks at the Complex are regularly used to provide overhaul, maintenance, conversion, refueling, defueling, and repair services to all classes of Navy vessels. Drydock 6, one of the largest in the world, is large enough to contain a nuclear-powered aircraft carrier. The drydocks are also central to PSNS' role as the nation's sole recycler of retired nuclear submarines and vessels. NSB serves as home port for several Navy vessels and provides long-term care of inactive naval vessels. Related land uses include an assortment of industrial support functions such as a power plant, warehousing, a steel yard, public work shops, and parking and facilities to provide a wide range of services to military personnel, including housing, retail goods and services, recreation, and dental care. Access to the Complex facility itself, including the shoreline, is strictly controlled and is limited to authorized personnel. Current uses of the upland portions of OU B are expected to remain relatively unchanged into the foreseeable fixture.

Kitsap County regards public access along Sinclair Inlet outside of the Complex as a desirable planning priority.

Water access in the cities of Bremerton and Port Orchard is provided mainly via public and private marinas for commercial and private vessels. A marina is located northeast of the Complex near the State ferry dock in the City of Bremerton, and eight marinas exist along the shoreline of the City of Port Orchard.

The Washington State Department of Transportation maintains an active regional ferry terminal adjacent to the Complex. A small privately operated ferry connects Port Orchard and Bremerton across Sinclair Inlet.

The cities of Bremerton and Port Orchard are both committed to developing improved recreational opportunities and public access to Sinclair Inlet, consistent with the designation of the inlet by the State as a Class "A" water body. Possibilities under consideration reportedly include additional beach access, boardwalks, and pedestrian and bicycle paths. It does not appear that the potential measures to improve public access to the inlet would directly impact OU B.

7.2 RESOURCE USES

The primary use of marine resources within Sinclair Inlet involves several fisheries. However, no fishing is permitted within the Complex, because it is perceived to be inconsistent with industrial use of the site and access is limited because of safety and security considerations.

7.2.1 Salmon Fisheries

Salmon fisheries in Sinclair Inlet depend primarily on two species of salmon, chinook and chum. The chinook fishery targets adults returning to the hatchery on (Jorst Creek. This hatchery has been operated since 1982 by the Suquamish Tribe in cooperation with WDFW, the City of Bremerton, and the Poggie Club.

Chum salmon are by far the most abundant of the salmon indigenous to Sinclair Inlet. All of the four main tributaries to the inlet support healthy fall chum runs. These fish enter the area in October, reaching natal streams in mid-November. In addition to the fall runs, one inlet tributary supports awn of "summer" chum. These fish typically arrive during late summer and move into fresh water during September.

Commercial non-tribal salmon fisheries are not presently permitted in Sinclair Inlet and adjoining waters. However, there is a small non- tribal sport fishery for returning chinook, chum, and coho in the fall in Sinclair Inlet and its main tributaries. There is usually moderate sport fishing for salmon from September through November in areas off the Bremerton shoreline and in Port Washington Narrows. WDFW did not allow sport fishers to take hatchery chinook in 1998, because of concern that the fishery could intercept wild chinook returning to other area streams.

Sinclair Inlet is part of the Suquamish Tribe's usual and accustomed fishing area. The inlet supports a tribal fishery that is primarily commercial, but includes some subsistence use. Sinclair Inlet accounts for 98 percent of the tribal commercial chinook catch. The majority of the fishing is concentrated in the vicinity of the Complex and gradually moves westward as the fish progress toward Gorst Creek.

7.2.2 Other Fisheries

At present there is little or no commercial fishing for bottomfish or forage fish in Sinclair Inlet. However, the sandy southern shore of the inlet has supported a regular sport fishery, targeting Pacific cod, lingcod, starry flounder, sole, and rockfish. The Bremerton- Kitsap County Health District has issued a health advisory against the consumption of rockfish and bottomfish from throughout Sinclair Inlet, based on evidence of chemical contaminants such as PCBs and mercury at levels of concern in fish tissues.

The waters around Ross Point support a recreational surf smelt fishery. This fishery has declined in recent years, due in part to reduced availability of smelt and to health advisories against the consumption of bottomfish. A low- intensity commercial harvest of pile perch occurs in Sinclair Inlet.

7.2.3 Shellfisheries

At present there is no commercial shellfishing in Sinclair Inlet, because of health advisories issued by the Bremerton-Kitsap County Health District. The Washington State Department of Health has never certified the commercial harvest of bivalves from the inlet because of high fecal coliform counts. There has been infrequent recreational clamming and collection of Dungeness crab in the inlet, but public advisories against the consumption of shellfish and crab from the inlet have also been issued.

A commercial sea cucumber fishery has operated intermittently in Sinclair Inlet under the State's rotational fishing plan for these species. The sea cucumber harvest in Sinclair Inlet was suspended for the 1994- to- I 997 cycle because of human health concerns related to accumulated tissue levels of contaminants such as PCBs.

8.0 SUMMARY OF SITE RISKS

The baseline risk assessment for OU B estimated the risks that could exist if no remedial actions were taken, considering both current and potential future land uses. This risk assessment included evaluations of both human health risk and ecological risk. Both the upland and marine components of OU B were addressed in this risk assessment; the conclusions of the assessment of the marine component are summarized below. The results of the risk assessment were used to evaluate the need for remedial action at marine OU B.

8.1 HUMAN HEALTH RISK ASSESSMENT

The baseline human health risk assessment (HHRA) for OU B provides a quantitative and qualitative evaluation of potential risk to humans from contact with chemicals identified in the marine portion of the site.

8.1.1 Identification of Chemicals of Potential Concern

In order to focus the risk assessment on those chemicals with the most potential significance for human health, the chemical results were initially screened to identify chemicals of potential concern (COPCs). This screening was performed separately on subsets of the overall OU B database appropriate to the overall structure of the risk assessment. For the marine HHRA, five separate data groups were screened for COPCs:

- Marine sediment within the Complex boundary
- Marine sediment within Sinclair Inlet but outside the Complex boundary
- Sea cucumber tissue
- English sole fillet tissue
- Mussel tissue

There were three primary criteria involved in the COPC screening process:

- The chemical must have been detected in at least 5 percent of the samples.
- For inorganic chemicals, the maximum detected concentration must have exceeded the concentration measured at a comparatively undisturbed background location.
- The maximum detected concentration must exceed an appropriate conservative risk-based screening concentration (RBSC). The RBSCs were defined as the lower of the concentrations calculated to result in a hazard quotient (HQ) of 0.1 or an increased lifetime cancer risk I x 10-7 .

EPA guidance suggests that emphasis be placed in the record of decision on those chemicals that are the primary basis for remedial action at a site, referred to as chemicals of concern (COCs) or risk drivers. Although the risk assessment did not explicitly identify the COCs, a list of those chemicals that contribute the majority of the projected site risks for each of the five marine human health scenarios has been identified, based on the risk assessment results. These COCs, which are shown in Table 8-1, are used as the basis for this summary of the marine HHRA for marine OU B.

8.1.2 Exposure Assessment

The purpose of the exposure assessment is to identify human receptors potentially at risk and estimate the type and magnitude of exposures to the COPCs identified at the site. The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential risks.

The exposure assessment process involves four steps: (1) characterizing the exposure setting, (2) identifying exposure pathways, (3) calculating exposure point concentrations, and (4) quantifying exposure in the form of chemical intakes.

The exposure setting for marine OU B is based on current and hypothetical future land uses at the site, Five human health exposure scenarios were evaluated: subsistence and recreational finfish harvesting, subsistence and recreational sea cucumber harvesting, and subsistence shellfish harvesting. Because the Complex is a secure naval facility, harvesting of finfish and sea cucumbers is assumed to occur using boats in areas outside the Complex boundary. Sea cucumber harvesting is assumed to be performed by divers. Very little intertidal area suitable for shellfish collection exists at OU B, and information to support an evaluation of this exposure scenario is limited. The evaluation made use of the results of the caged mussel study and analyses of sediment samples collected in the nearshore area off of OU A. Table 8-2 summarizes the exposure pathways and site media included in these five scenarios.

Exposure point concentrations (EPCs) are concentrations of individual chemicals to which an individual may potentially be exposed for each medium. EPCs were developed based on EPA guidance using data collected at the site during the 1990—1991 site inspection and the 1994—1995 remedial investigation.

For these marine scenarios, reasonable maximum exposure point concentrations or RMEs were used as EPCs. RMEs are intended to provide a conservative estimate of chemical exposure, well above the average potential exposure but within the range of possible exposures. RMEs represent the highest exposures reasonably expected to occur at a site.

In most cases, the 95 percent upper confidence limit (UCL95) on the arithmetic mean of the RI data is used as the RME, However, for a few chemicals only limited data were collected and large variability in the reported results led to a computed UCL9S exceeding the maximum reported concentration. In these cases, the maximum reported concentration was used as the RME.

Toxicity information for arsenic is based on ingestion of inorganic arsenic. However, an assessment of potential health risks from consumption of seafood from Puget Sound notes that as little as 1 percent of the arsenic present in marine tissues typically occurs in the inorganic form, the remainder exist in organic forms, which are considerably less toxic. The HHRA used the conservative assumption that 10 percent of the arsenic concentrations reported iii marine tissues represented inorganic arsenic.

The EPCs used for the chemicals of concern for marine tissues are summarized in Tables 8-3 through 8-5. The EPCs used for marine sediment assumed to be incidentally ingested with shellfish and English sole are shown in Tables 8-6 and 8-7.

A survey of seafood ingestion in two Puget Sound area Tribes, the Tulalip and Squaxin, provided the best information available at the time the risk assessment was performed for assessing potential risks from seafood consumption. This survey was conducted shortly before the publication of the draft 011 B RI report. The 95th percentile values recorded for finfish and shellfish consumption in this survey were used as the subsistence finfish and shellfish ingestion rates in the risk assessment. The results of a study of seafood consumption by Alaskan natives were used to estimate sea cucumber ingestion rates.

It was assumed that only one- half of the ingested finfish and shellfish would be collected in the inlet to partly account for the fact that there are many locations besides Sinclair Inlet in the area where seafood can be collected. However, based on the lower frequency of harvest expected for sea cucumber, all of the ingested sea cucumber was assumed to be collected from the inlet.

Table 8-8 summarizes the exposure parameters used in performing the HHRA for marine OU B.

8.1.3 Toxicity Assessment

The toxicity assessment involves:

- Hazard identification, which weighs the available evidence of the potential adverse effects of chemicals on exposed individuals

- Dose-response assessment, which estimates the relationship between the magnitude of exposure to chemicals and the likelihood or severity of adverse effects

The primary component of hazard identification is the assembling of a toxicological summary consisting of toxicity profiles for the COPCs for the site. These profiles include chemical-specific information regarding the potential for exposure, pharmacokinetics, critical health —effects, and the relationship of these effects to chemical exposures.

The dose-response assessment is intended to quantify the correlation between the magnitude of chemical exposure and potential resulting adverse health effects. This typically involves analyses of the severity or frequency of adverse effects and the exposure levels at which these effects occur using information from the toxicological literature. The objective of the analyses is to define dose-response relationships for oral ingestion, inhalation, and dermal contact.

The results of dose-response analyses take the form of toxicity values known as reference doses (RfDs) for noncarcinogenic (noncancer) effects and cancer slope factors (CSFs) for carcinogenic (cancer) effects. Some chemicals can produce both cancer and noncancer effects. Toxicity values are available for the ingestion pathway for many chemicals and are available for the inhalation pathway for some chemicals, but are not typically available for the dermal exposure pathway. Dermal toxicity values were derived from oral ingestion toxicity values based on EPA guidelines.

Noncancer effects are defined as all health effects other than cancer. For most noncancer effects, a mechanism is believed to exist that protects an exposed individual from adverse effects until a threshold level of exposure is reached. Laboratory studies are commonly used to gain insight on threshold values for specific chemicals. Although the ultimate objective of such studies is to establish the safe dose for a human, most such studies are carried out on laboratory animals. The results are commonly extrapolated to humans using conservative uncertainty factors to allow for influences such as individual variations in response to chemicals, together with modifying factors based on the perceived quality of the toxicological database for a given chemical.

RfDs were obtained in most cases from the EPA’s Integrated Risk Information System (IRIS) database. In those cases where the IRIS database does not include RfDs for a particular chemical, values were obtained from the EPA’s Health Effects Assessment Summary Tables (HEAST). Table 8-9 summarizes the toxicity data for noncancer effects.

The mechanisms leading to the development of cancer are believed to differ from the mechanisms of noncancer effects. No safe threshold level is believed to exist for exposure to cancer-causing chemicals, so a different form of toxicity value is associated with cancer effects. Cancer toxicity is generally expressed for risk assessment purposes with a combination of a weight-of-evidence classification and a CSF. The weight-of-evidence classification indicates the likelihood of a chemical causing human cancer based on the strength of the supporting animal and human testing data. CSFs are developed for those chemicals perceived as likely to cause cancer in humans. Most CSFs for this risk assessment were obtained from the IRIS database. Where the IRIS database did not include CSFs for a chemical, values were obtained from the HEAST publication. Table 8-10 summarizes the cancer toxicity values.

8.1.4 Human Health Risk Characterization

Risk characterization integrates the results of the toxicity and exposure assessments into a quantitative description of potential noncancer and cancer risks. Because of fundamental differences in the handling of noncancer and cancer effects, the respective risks are characterized separately.

Noncancer Risks

The potential for noncancer risks is evaluated by comparing the estimated intake of a chemical over a specific time period with the reference dose for that chemical derived for a similar exposure period. This comparison yields an HQ, not a measure of potential incidence or severity of effect but an index as to whether a particular chemical exposure constitutes a potential health risk. Individual HQs calculated for each of the chemicals in cases of exposure to multiple chemicals are added to produce a hazard index (HI).

An HI less than or equal to I is interpreted to mean that no adverse noncancer health effects are likely. An HI above 1 suggests the possibility of noncancer health risk, and the degree of concern increases with increasing HI. In practice, FITs between 1 and 10 are often interpreted to suggest a comparatively minor risk of noncancer effects given the conservative nature of the risk assessment process.

Table 8-11 summarizes the results of the noncancer risk characterization. The FIT computed for the subsistence finfisher is 12, due almost entirely to the presence of PCBs in fish tissue.

Besides PCBs no other chemical has an HQ above 1 for any of the scenarios. Mercury in fish tissue, the second- most significant contributor to the HI, has an HQ of approximately 0.4.

The Hl for the future subsistence shellfishing scenario is 2, due primarily to PCBs and chromium in shellfish tissue. None of the chemicals in this scenario has an individual HQ above 1.

None of the other human health scenarios has an HI above I.

Cancer Risks

Potential cancer risks are commonly presented as the increased probability of an individual developing cancer during their lifetime from exposure to cancer-causing chemicals. The resulting probabilities are expressed as the number of additional cancer cases likely for a specified population in addition to those cancers expected to occur because of existing exposures not connected with conditions at the site under investigation. For example, I additional cancer case expected in a population of 1,000,000 (i.e., one in a million) is expressed as an excess cancer risk of I x 10-6 or simply 10-6(frequently simplified to IE-6 in tabular presentations).

Because of the conservatism inherent in cancer slope factors, predicted cancer risks typically represent upper bound values; the actual risk is not likely to exceed the estimated risk and may be substantially lower. The EPA has identified an upper limit of l0~ for excess cancer risk, while Ecology uses a limit of 1 x 10~5

Table 8-12 summarizes the results of the cancer risk characterization. The excess cancer risk for the subsistence finfish harvester is 5 x 10~, due almost entirely to PCBs in fish tissue. In contrast, the cancer risk for the recreational finfish harvester is 2 x 1 o- 5 , which is below the EPA guideline but slightly above the Ecology guideline.

The cancer risk for the future subsistence shellfish harvester is I x 10-4 , which is above Ecology’s guideline and equal to the EPA guideline. Most of the risk is from arsenic and PCBs in shellfish tissue.

The risk for the subsistence sea cucumber harvesting scenario is 2 x 10-5. However, the recreational sea cucumber scenario cancer risk is below both agency guidelines.

8.1.5 Uncertainty Analysis for Human Health Risk Assessment

Various sources of uncertainty influence the results of the risk assessment process. These uncertainties typically influence the degree of confidence in the HHRA results and are considered in using the results to make appropriate choices about potential remediation. A qualitative summary of several of the primary uncertainties in the marine HHIRA for OU B is provided below.

A primary goal of the baseline risk assessment process is to avoid underestimating risk, for example, by using conservative screening methods. Consequently, the risk assessment results also tend to be conservative. However, the conservative screening methods are not generally considered an appropriate basis for setting cleanup levels without further refinement.

The subsistence seafood harvesting scenario involves a number of assumptions likely to cause overestimation of potential risk. For example the analysis assumes that all sea cucumbers and half of all finfish and shellfish consumed are collected from Sinclair Inlet, despite numerous alternative sites for seafood harvesting in the area.

There are at least three major sources of uncertainty associated with the shellfish harvesting exposure scenario. Because this scenario was a comparatively late addition to the remedial investigations, the field work did not include any collection of naturally occurring shellfish from the site. Instead the results of the caged mussel study conducted to support the ecological risk assessment were adopted as the best information available on shellfish tissue chemical levels. However, the mussels were only exposed to inlet conditions for 3 months and were suspended 1 meter above the seafloor and, thus, not in contact with sediment as clams would be. A second primary source of uncertainty for this scenario is that only a very small area at the Complex appears to have conditions that could support clams, and access to much of this area is prohibited. Thus, the idea of the OU B site being a significant component in a future subsistence shellfish consumption scenario is highly implausible. A third source of uncertainty in the subsistence shellfish scenario is the use of the results of chemical analyses of shallow nearshore sediments in the OU A area. These data were used because this is the one area at OU B that appears capable of supporting significant numbers of clams.

Detection limits significantly exceeding the RBSCs for individual chemicals are a common source of uncertainty. By convention, a reported nondetection of a chemical is represented numerically by a value of one- half the detection limit in risk assessment calculations. If the chemical is actually present at a concentration just below the detection limit, this convention would lead to an underestimate of risk. If the chemical is not actually present or is present at a very low concentration, use of one-half the detection limit to represent the unknown concentration will overestimate the risk. Detection limits significantly exceeded the RBSCs for PCBs and arsenic in sediment, two primary human health risk drivers, implying at least moderate uncertainty in the results.

Lack of toxicity values for some chemicals potentially could lead to a moderate underestimate of risk, since it prevents these chemicals from being included in the calculations.

In general, there is moderate to high uncertainty associated with the use of toxicity values to represent the potential risks of chemical exposure. In particular, although arsenic appears to be a human health risk driver, there is significant uncertainty associated with both potential noncancer and cancer effects of arsenic.

Exclusive use of reasonable maximum exposure values for exposure point concentrations for the marine HHRA scenarios likely tends to moderately overestimate site risks. The assumption that the exposure point concentrations remain constant throughout the exposure duration, which ranges between 30 and 70 years, also likely moderately overestimates risk.

Using results from English sole tissue to represent all varieties offish consumed by a seafood harvester likely introduces moderate uncertainty. The most probable outcome is an overestimate of risk since an actual seafood diet would likely include species such as salmon that tend to spend less time in contact with sediment than sole and, hence, can be expected to have lower chemical levels.

The assumption that risks from various chemicals are additive is an oversimplification. In some cases, the effect of one chemical can increase the effect of another chemical (synergism) while in other cases one chemical may suppress the effect of another (antagonism).

Overall there is a low probability that the actual risks were underestimated and a high probability that risks were overestimated.

8.2 ECOLOGICAL RISK ASSESSMENT

The primary components of the OU B ecological risk assessment were evaluations of the potential effects of exposure to site conditions on four categories of indicator animals:

- Benthic invertebrates
- Shellfish
- Bottom-dwelling fish
- Marine birds

EPA guidance suggests that the record of decision focus on a subset of the COPCs typically identified during the risk assessment process. This subset, commonly referred to as the chemicals of concern or COCs, is made up of those COPCs that are the greatest causes of risk. The OU B ecological risk assessment did not explicitly identify a set of COCs. However, the risk assessment findings suggest that the primary risk contributors for each of the four primary ecological risk assessment components are those chemicals shown in Table 8-13. For marine sediment, the COCs are those chemicals that most frequently exceeded regulatory or biological effects criteria. For mussels, English sole, and marine birds, the COCs are those chemicals that had an associated hazard quotient greater than 1.

8.2.1 Benthic Invertebrates

Three separate techniques were used to assess potential risk to marine life living in or on marine sediment. Concentrations of chemicals measured in sediment samples were compared to regulatory criteria. The results of bioassay tests were evaluated in which three different marine species were exposed to sediments. Surveys of marine life actually living in sediments at the site were compared to a survey performed at a relatively undisturbed location in the central inlet approximately 1 mile southwest of Mooring G.

A variety of organic and inorganic chemicals have been found to be present in Sinclair Inlet sediments at concentrations exceeding regulatory criteria. Table 8-14 summarizes the findings for the sediment COCs, bis(2-ethylhexyl) phthalate, copper, mercury, PCBs, and zinc. Mercury is found at concentrations exceeding the Washington State SQS value throughout much of the inlet. The highest measured concentrations of the other sediment COCs generally occur in the vicinity of the Naval Complex.

The results of bioassay tests on 34 sediment samples showed that despite evidence of chemical contamination, the sediments in the inlet pose relatively little risk to standard test species. Out of the 34 sediment samples, 19 had no adverse effects on the test species. Minor adverse effects were found for 15 of the samples. There was no apparent difference in the results for samples collected in the immediate vicinity of the Complex and those collected in more distant parts of the inlet.

The abundance and variety of benthic community species actually living in marine sediment adjacent to the Naval Complex were compared to more distant areas of Sinclair Inlet. A wide variety of statistical measures were calculated and used in this comparison, such as species richness, trophic index, and species diversity. For several measures, there was no apparent difference between survey locations at the Complex and in other parts of the inlet. The overall conclusion is that there is limited evidence of modest impact to the benthic community at the Complex. Chemical contamination is likely a contributor to the observed impact, but there is also evidence that elevated levels of carbon in the sediments may be a more significant cause of stress. Within the Naval Complex disturbance of the sediments caused by the movements of naval vessels likely also has an impact on marine species living in or on the sediment.

Because of uncertainties, such as in the actual availability to marine life of chemicals in sediment, direct tests of biological effects, such as bioassays and benthic community studies, take precedence under the State SMS over sediment chemical measurements in interpreting potential site risks. At OU B, while chemical contamination is found, direct biological testing shows relatively little evidence of impact. The overall conclusion of the evaluation of benthic invertebrates is that conditions at OU B pose at most a relatively minor threat to these marine species.

8.2.2 Shellfish

A caged mussel test was conducted during the remedial investigation to evaluate potential risks to shellfish and similar marine species. Young mussels were suspended above the seafloor in several locations in Sinclair Inlet and at a reference location for a period of3 months (Figure 6-7). At the completion of the test, physical parameters, such as individual mussel survival and growth, were recorded and chemical analyses were performed on the mussel tissues.

As shown in Table 8-13, the two COCs identified for mussels are chromium and selenium. Table 8-15 presents the chemical concentrations found in the Sinclair Inlet samples for the mussel COCs. RME concentrations representing the high end of the potential concentrations expected based on measured tissue levels are compared to toxicity reference values, which are chemical levels previously shown to lead to adverse effects in laboratory studies.

Almost all of the individual mussels survived at all test locations. While there was some variation between the Sinclair Inlet stations and the reference station in the physical parameters measured at the end of the caged mussel test, the results were generally inconclusive.

The overall conclusion is that while mussels were prone to accumulate more chemicals in their tissues in Sinclair Inlet than in the reference location, inlet conditions overall posed only minimal risk.

8.2.3 Bottom-Dwelling Fish

English sole, a commonly used test species, were collected from Sinclair Inlet and a reference location as the basis for evaluating potential risk posed by conditions at OU B to bottom-dwelling fish. Chemical analyses on tissue samples from the sole were used to evaluate the extent of bioaccumulation of chemicals. In addition, livers from the sole were examined for evidence of lesions commonly associated with contact with contaminated sediment.

Table 8-16 presents the results of the analyses of English sole tissue samples. RME tissue concentrations for the English sole COCs antimony, chromium, and lead are compared to toxicity reference values.

Very few lesions were found in livers from the English sole collected in Sinclair Inlet. The frequency of liver lesions is comparable to that found in relatively undeveloped portions of Puget Sound.

Overall the conclusion of the English sole evaluation is that there is very little evidence of the types of stress which trigger the development of liver lesions, but some indication of limited risk to bottom-dwelling fish from antimony, chromium, and lead.

8.2.4 Marine Birds

The last primary element in the ecological risk assessment for OU B consisted of modeling to evaluate potential risks to marine birds consuming prey species characteristic of conditions at OU B, ingesting seawater, and incidentally ingesting marine sediment. Two bird species, the surf scoter and pigeon guillemot, were used in this modeling work. The surf scoter was used to represent shellfish-eating birds, while the pigeon guillemot represented fish-eating birds. Results of analyses of the OU B mussel and English sole tissue samples were used, together with sediment and inlet water sample results, as the basis for the modeling.

Besides the marine bird modeling performed for OU B, a separate set of modeling done previously was also reported with the OU B risk assessment. This earlier modeling work represented a preliminary evaluation of possible risks to spotted sandpiper from conditions observed at Operable Unit A at the southwest end of the Naval Complex.

The assumptions associated with the earlier sandpiper modeling are highly unrealistic. For example, the earlier modeling utilized sediment data collected prior to the remedial action carried out at that site and also assumed that the sandpiper would forage exclusively at the very limited beach area at OU A. Consequently, while the earlier modeling initially suggests a pronounced risk to sandpipers from inorganics in sediment and prey species, the modeling results are not representative of current site conditions or likely sandpiper behavior and are not a sound basis for remedial action. However, for the sake of completeness the results of the sandpiper modeling are presented together with the surf scoter and pigeon guillemot results in Table 8-17. The results for the surf scoter and pigeon guillemot suggest a limited potential for risk, although comparison of model parameters with conditions at background areas suggest the actual risks are minor.

8.2.5 Uncertainty Analysis for Ecological Risk Assessment

As discussed above for the human health risk assessment, there are numerous sources of uncertainty associated with ecological risk assessment that should be taken into consideration in interpreting the assessment results. Examples are summarized below of some of the primary apparent sources of uncertainty in predicting ecological risk.

One potential source of uncertainty that can effect any risk assessment component that relies on sediment sampling is the difficulty of collecting representative samples. For example, use of single grab samples for chemical analyses and bioassays tends to mask the effects of natural variability in the environment.

Limitations in available toxicity information for some chemicals can lead to moderate uncertainties. For example, lack of specific toxicity values may prevent certain chemicals from being included in risk calculations and even incomplete or otherwise limited information tend to reduce the reliability of results. These effects contributed significant uncertainty to several of the ecological risk assessment components, including the analyses of risks to the benthic community, caged mussels, and English sole, as well as marine bird food-chain modeling.

Table 8-1
Human Health Chemicals of Concern

Chemical of Concern	Human Health Scenario				
	Finfisher		Sea Cucumber Harvester		Shellfish Harvester
	Subsistence	Recreational	Subsistence	Recreational	Subsistence
PBCs	!	!	!	!	!
Bis(2-ethylhexyl)phthalate	!	!			!
Heptachlor	!				
Aldrin	!	!			
Benzo(a)pyrene	!		!	!	!
Mercury	!				
Arsenic	!		!	!	!
Chromium					!
Selenium					!

Note:
PCB: Polychlorinated biphenyl

Table 8-2
Human Health Exposure Scenarios

Scenario		Ingestion of Chemicals in Tissue	Ingestion of Chemicals in Sediment	Dermal Contact with Chemicals in Sediment
Finfisher	Subsistence	!	!	!
	Recreational	!		
Sea Cucumber Harvester	Subsistence	!	!	!
	Recreational	!		
Shellfish Harvester	Subsistence	!	!	!

Table 8-3
Summary of Chemicals of Concern and Exposure-Point Concentrations for Mussel Tissue

Chemical of Concern	Concentration Detected (mg/kg wet weight)		Frequency of Detection	Exposure Point Concentration (mg/kg wet weight)	Statistical Measure
	Minimum	Maximum			
Aroclor 1254	0.0092	0.021	9/12	0.021	Maximum
Mercury	0.01	0.02	12/12	0.0193	UCL95
Arsenic	0.42	0.92	12/12	0.0586	UCL95
Chromium	0.5	1.9	12/12	1.12	UCL95
Selenium	1.01	1.1	12/12	1.05	UCL95

Notes:
mg/ kg - milligram per kilogram
UCL95 - 95 percent upper confidence limit

Table 8-4
Summary of Chemicals of Concern and Exposure-Point Concentrations for English Sole Tissue (Fillets)

Chemical of Concern	Concentration Detected (mg/kg wet weight)		Frequency of Detection	Exposure Point Concentration (mg/kg wet weight)	Statistical Measure
	Minimum	Maximum			
Aroclor 1260	0.0297	0.214	20/20	0.2	UCL95
Bis(2-ethylhexyl)phthalate	0.64	1.4	2/20	1.4	Maximum
Heptachlor	0.0005	0.0034	11/20	0.00215	UCL95
Aldrin	0.0004	0.001	10/20	0.001	Maximum
Mercury	0.03	0.05	20/20	0.0382	UCL95
Chromium	0.06	0.33	12/20	0.126	UCL95

Notes:
mg/kg - milligram per kilogram
UCL95 - 95 percent upper confidence limit

Table 8-5
Summary of Chemicals of Concern and Exposure-Point Concentrations for Sea Cucumber Tissue

Chemical of Concern	Concentration Detected (mg/kg wet weight)		Frequency of Detection	Exposure Point Concentration (mg/kg wet weight)	Statistical Measure
	Minimum	Maximum			
Total PCBs	0.0015	0.056	29/29	0.0482	UCL95
Benzo(a)pyrene	0.0000002	0.0043	25/29	0.00169	UCL95
Arsenic	0.11	2.44	29/29	0.0978 a	UCL95

a Concentration derived from 0.1 times measured arsenic concentrations in tissue, based on lower toxicity of organic forms of arsenic.
Notes:
mg/kg - milligram per kilogram
PD - polychiorinated biphenyl
UCL95 - 95 percent upper confidence limit

Table 8-6
Summary of Chemicals of Concern and Exposure-Point Concentrations for Marine Sediment Associated with Shellfish

Chemical of Concern	Concentration Detected (mg/kg wet weight)		Frequency of Detection	Exposure Point Concentration (mg/kg wet weight)	Statistical Measure
	Minimum	Maximum			
Total PCBs a	0.034	1.7	37/86	0.393	UCL95
Bis(2-ethylhexyl) phthalate	0.26	40	59/86	2.65	UCL95
Benzo(a)pyrene	0.026	9.7	81/86	0.923	UCL95
Arsenic	4	111	83/86	28.4	UCL95
Chromium	24.4	168	86/86	69.4	UCL95

a Reflects historical sediment PCB analyses, not 1999 to 2000 focused sediment PCB sampling.
Notes:
mg/kg - milligram per kilogram   PCB - polychlorinated biphenyl   UCL95 - 95 percent upper confidence limit

Table 8-7
Summary of Chemicals of Concern and Exposure-Point Concentrations for Marine Sediment Associated with English Sole

Chemical of Concern	Concentration Detected (mg/kg wet weight)		Frequency of Detection	Exposure Point Concentration (mg/kg wet weight)	Statistical Measure
	Minimum	Maximum			
Total PCBs a	0.011	2.27	19/24	0.372	UCL95
Benzo(a)pyrene	0.024	2	21/24	0.815	UCL95
Arsenic	3.6	20	24/24	14.2	UCL95
Chromium	27.6	97.4	24/24	59.6	UCL95

a Reflects historical sediment PCB analyses, not 1999 to 2000 focused sediment PCB sampling.

Notes:
mg/kg - milligram per kilogram
PCB - polychlorinated biphenyl
UCL95 - 95 percent upper confidence limit

Table 8-8
Human Health Exposure Parameters

Exposure Pathway	Parameter	Unit	Finfisher		Sea Cucumber Harvester		Shellfish Harvester
			Subsistence	Recreational	Subsistence	Recreational	
Common to all pathways	Exposure duration	year	70	30	70	30	70
	Averaging time - cancer	day	25,550	25,550	25,550	25,550	25,550
	Averaging time - noncancer	day	25,550	10,950	25,550	10,950	25,550
Ingestion of chemicals in marine tissue	Tissue ingestion rate	g/day	177	12.3	4.5	1.9	117
	Fraction ingested from site	unitless	0.5	0.5	1	1	0.5
	Exposure frequency	days/year	365	365	365	365	365
	Body weight	kb	81	70	70	70	81
Ingestion of chemicals in sediment	Sediment ingestion rate	mg/day	100	NA	100	NA	100
	Exposure frequency	days/year	365	NA	4	NA	100
	Body weight	kb	81	NA	81	NA	81
Dermal contact with chemicals in sediment	Skin surface area	cm2	1,900	NA	1,900	NA	1,900
	Soil-to-skin adherence factor	mg/cm2-event	1	NA	1	NA	1
	Exposure frequency	events/year	365	NA	4	NA	100
	Body weight	kg	81	NA	81	na	81

Notes:
cm2 - square centimeter
g - grain
kg - kilogram
mg - milligram
NA - not applicable (exposure pathway not evaluated quantitatively)

Table 8-9
Noncancer Toxicity Data Summary

Chemical of Concern	Length of Exposure a	Oral Reference Dose (mg/kg-day)	Oral Combined Uncertainty/ Modifying Factors	Primary Oral Target Organ	Inhalation Reference Dose (mg/kg-day)	Inhalation Combined Uncertainty/ Modifying Factors	Primary Inhalation Target Organ	Source
Total PCBs	chronic	0.00002	300	immune system	NA	NA	NA	USEPA 1998
	subchronic	0.00005	100	NA	NA	NA	NA	USEPA 1997
Bis(2-ethylhexyl) phthalate	chronic	0.02	1,000	liver	NA	NA	NA	USEPA 1998
Heptachlor	chronic	0.0005	300	liver	NA	NA	NA	USEPA 1998
	subchronic	0.0005	300	NA	NA	NA	NA	USEPA 1997
Aldrin	chronic	0.00003	1,000	liver	NA	NA	NA	USEPA 1998
	subchronic	0.00003	1,000	NA	NA	NA	NA	USEPA 1997
Mercury (inorganic)	chronic	0.0003	1,000	immune system	0.00009	30	central nervous system	USEPA 1998
	subchronic	0.003	100	NA	NA	NA	NA	USEPA 1997
Mercury (methyl)	chronic	0.0001	10	developmental	NA	NA	NA	USEPA 1998
	subchronic	0.0001	10	NA	NA	NA	NA	USEPA 1997
Arsenic	chronic	0.0003	3	SKIN	NA	NA	NA	USEPA 1998
	subchronic	0.0003	3	NA	NA	NA	NA	USEPA 1997
Chromium VI	chronic	0.003	900	none	0.00003	300	lungs	USEPA 1998
	subchronic	0.02	100	NA	NA	NA	NA	USEPA 1997
Selenium	chronic	0.005	3	whole body			NA	USEPA 1998
	subchronic	0.005	3	NA	NA	NA	NA	USEPA 1997

a chronic exposure is longer than 7 years; subchronic is between 2 weeks and 7 years.

Notes:
mg/kg-day - milligram per kilogram per day
NA - not available or not applicable
PCB - polychlorinated biphenyl
USEPA - U. S. Environmental Protection Agency

Table 8-10
Cancer Toxicity Data Summary

Chemical of Concern	Oral Cancer Slope Factor (mg/kg-day)	Inhalation Cancer Slope Factor (mg/kg-day)	Weight-of-Evidence Class	Source
Total PCBs	2	2	B2	USEPA 1998
Bis(2-ethylhexyl) phthalate	0.014	NA	B2	USEPA 1998
Heptachlor	4.5	4.5	B2	USEPA 1998
Aldrin	17	17	B2	USEPA 1998
Benzo(a) pyrene	7.3	NA	B2	USEPA 1998
Mercury	NA	NA	C	NA
Arsenic	1.5	15	A	USEPA 1998
Chromium	NA	42	A	USEPA 1998

Notes:
A - human carcinogen
B2 - probable human carcinogen (sufficient evidence in animals, but inadequate evidence in humans)
C - possible human carcinogen
mg/kg-day - milligram per kilogram per day
NA - not available
PCB - polychlorinated biphenyl
USEPA - U. S. Environmental Protection Agency

Table 8-11
Human Health Risk Characterization Summary — Noncarcinogens

Chemical of Concern	Hazard Quotient			Total Hazard Quotient
	Ingestion of Chemicals in Tissue	Ingestion of Chemicals in Sediment	Dermal Contact with Chemicals in Sediment	
Subsistence Finfisher				
Total PCBs	11	0.023	0.061	11
Bis(2-ethylhexyl) phthalate	0.076	- -	- -	
Mercury (methyl)	0.42	- -	- -	0.42
Arsenic	- -	0.058	- -	0.058
			Hazard Index	12
Recreational Finfisher				
Total PCBs	0.88	- -	- -	0.88
			Hazard Index	0.9
Subsistence Sea Cucumber Harvester				
Total PCBs	0.15	0.00025	0.00067	0.16
			Hazard Index	0.2
Recreational Sea Cucumber Harvester				
Total PCBs	0.065	- -	- -	0.065
			Hazard Index	0.7
Subsistence Shellfish Harvester				
Total PCBs	0.76	0.0066	0.018	0.78
Mercury (methyl)	0.14	- -	- -	0.14
Arsenic	0.14	0.032	- -	0.17
Chromium	0.27	0.0078	- -	0.28
Selenium	0.15	- -	- -	0.15
			Hazard Index	2

Note:
PCB - polychlorinated biphenyl

Table 8-12
Human Health Risk Characterization Summary — Carcinogens

Chemical of Concern	Hazard Quotient			Total Cancer Risk
	Ingestion of Chemicals in Tissue	Ingestion of Chemicals in Sediment	Dermal Contact with Chemicals in Sediment	
Subsistence Finfisher				
Total PCBs	4.4E-04	9.2E-07	2.4E-06	4.4E-04
Bis(2-ethylhexyl) phthalate	2.1E-05	- -	- -	2.1E-05
Heptachlor	1.1E-05	- -	- -	1.1E-05
Aldrin	l.9E-05	- -	- -	l.9E-05
Benzo(a)pyrene	- -	7.3E-06	- -	7.3E-06
Arsenic	- -	2.6E-05	- -	2.6E-05
TOTAL CANCER RISK	5E-04	4E-05	2E-06	5E-04
Recreational Finfisher				
Total PCBs	1.5E-05	- -	- -	1.5E-05
Bis(2-ethylhexyl) phthalate	7.4E-07	- -	- -	7.4E-07
Aldrin	6.4E-07	- -	- -	6.4E-07
TOTAL CANCER RISK	2E-05	- -	- -	2E-05
Subsistence Sea Cucumber Harvester				
Total PCBs	6.2E-06	l.0E-O8	2.7E-08	6.2E-06
Arsenic	9.4E-06	2.9E-07	- -	9.7E-06
TOTAL CANCER RISK	2E-05	4E-07	3E-08	2E-05
Recreational Sea Cucumber Harvester				
Total PCBs	1.1E-06	- -	- -	1.1E-06
Benzo(a)pyrene	1.4E-07	- -	- -	1.4E-07
Arsenic	1.7E-06	- -	- -	1.7E-06
TOTAL CANCER RISK	3E-06	- -	- -	3E-06
Subsistence Shellfish Harvester				
Total PCBs	3.0E-05	2.7E-07	7.1E-07	3.1E-05
Bis(2-ethylhexyl) phthalate	- -	1.3E-08	2.4E-08	3.6E-08
Benzo(a)pyrene	- -	2.3E-06	- -	2.3E-06
Arsenic	6.2E-05	1.4E-05	- -	7.6E-05
TOTAL CANCER RISK	9E-05	2E-05	7E-07	1E-04

Note:

PCB - polychlorinated biphenyls

Table 8-13
Ecological Chemicals of Concern

Chemical of Concern	Ecological Risk Assessment Component			
	Marine Sediment a	Mussels b	English Sole b	Marine Birds b
Antimony			!	
Arsenic				!
Bis(2-ethylhexyl) phthalate	!			
Cadmium				!
Chromium		!	!	
Copper	!			!
Endrin				!
Endrin ketone				!
Lead			!	!
Mercury	!			!
PCBs	!			
Selenium		!		
Zinc	!			!

a Marine sediment chemicals of concern are chemicals that most frequently exceeded regulatory or biological effects criteria.
b Mussel, sole, and marine bird chemicals of concern are chemicals with a hazard quotient greater than 1.

Note:
PC - polychlorinated biphenyl

Table 8-14
Summary of Chemicals of Concern in Marine Surface Sediment at Naval Complex

Chemical of Concern	Concentration Detected (mg/kg)		Frequency of Detection	Sediment Quality Standard (mg/kg)	Number of SQS Exceedances
	Minimum	Maximum			
Bis(2-ethylhexyl) phthalate a	5	1,290	59/86	47	16
Copper	19	1,700	86/86	390	15
Mercury	0.15	6.5	88/88	0.41	78
PCBs a	2.263	54.8	37/86	12	12
Zinc	56.8	7,390	86/86	410	34

a Concentrations normalized to organic carbon (OC); units are mg/kg OC

Notes:
mg/ kg - milligrams per kilogram
PCB - polychlorinated biphenyl
SQS - sediment quality standard

Table 8-15
Summary of Chemicals of Concern in Mussel Tissue

Chemical of Concern	Concentration Detected (mg/kg)		Frequency of Detection	Reasonable Maximum Exposure (mg/kg)	Toxicity Reference Value (mg/kg)	Hazard Quotient
	Minimum	Maximum				
Chromium	0.5	1.9	12/12	1.1	0.28	3.9
Selenium	0.91	1.1	12/12	1.1	0.55	2
Hazard Index (all modeled chemicals)						8.6

Note:
mg/kg - milligram per kilogram

Table 8-16
Summary of Chemicals of Concern in English Sole Tissue

Chemical of Concern	Concentration Detected (mg/kg)		Frequency of Detection	Reasonable Maximum Exposure (mg/kg)	Toxicity Reference Value (mg/kg)	Hazard Quotient
	Minimum	Maximum				
Antimony	0.5	0.5	1/12	0.31	0.03	10
Chromium	0.27	0.74	6/12	0.37	0.28	1.3
Lead	0.31	1.2	12/12	0.93	0.49	1.9
Hazard Index (all modeled chemicals)						14

Note:
mg/kg - milligram per kilogram

Table 8-17
Summary of Chemicals of Concern for Marine Birds

Chemical of Concern	Composite Dosage (mg/kg-day)		Toxicity Reference Value (mg/kg-day)	Hazard Quotient	
	Mean	RME		Mean	RME
Surf Scoter					
Cadmium	0.15	0.17	0.14	1.1	1.2
Mercury	0.0089	0.01	0.0045	2.0	2.3
Hazard Index (all modeled chemicals)				5.1	5.6
Pigeon Guillemot					
Arsenic	0.95	1.2	0.38	2.4	3.1
Endrin	0.0013	0.00055	0.00055	2.7	1.1
Endrin ketone	0.0011	0.0004	0.0005	2.3	0.8
Mercury	0.01	0.012	0.0045	2.3	2.7
Hazard Index (all modeled chemicals)				12	10
Spotted Sandpiper					
Arsenic	4.5	5.4	0.38	11.2	13.6
Cadmium	0.9	1.7	0.14	6.4	11.9
Copper	30	45	24.7	1.2	1.8
Lead	17	24	2.5	6.8	9.6
Mercury	0.13	0.21	0.0045	28.3	47.0
Zinc	210	310	200	1.1	1.5
Hazard Index (all modeled chemicals)				57	88

Notes:
mg/kg-day - milligram per kilogram per day
RME - reasonable maximum exposure

9.0 REMEDIAL ACTION OBJECTIVES

9.1 NEED FOR REMEDIAL ACTION

Limited contact with marine sediment and occasional consumption of common seafood species from Sinclair Inlet do not appear to constitute significant human health risks. The most significant finding of the risk assessment is that unacceptable risks are posed to subsistence seafood harvesters relying on seafood collected in Sinclair Inlet as a principal component of their diet. These risks are primarily from the presence of PCBs in tissues of bottom-dwelling fish. Subsistence consumption of seafood with elevated levels of PCBs could expose a person to a chance of both cancer and noncancer health effects.

Although mercury has been found at concentrations above the State cleanup screening level of 0.59 mg/kg in marine sediments throughout much of Sinclair Inlet, a wide variety of marine studies completed during the RI indicate little or no ecological or human health risk from mercury.

Since the OU B risk assessment was completed, additional information has become available showing that mercury levels in rockfish, especially older fish, tend to be considerably higher than have been measured in English sole. This may be because rockfish live longer than sole and can accumulate chemicals for a longer time. The Kitsap County Health Department has issued an advisory recommending against consumption of rockfish from the inlet, and the recent findings are a source of concern. A study of rockfish tissue by Washington State Fish and Wildlife found some mercury concentrations greater than 1 mg/kg. U. S. Food and Drug Administration guidelines require that action be taken to prevent human consumption of fish with concentrations above 1 mg/ kg.

Elevated levels of a variety of chemicals are found in the surface marine sediments of Sinclair Inlet. However, the results of the ecological risk assessment suggest that chemicals in inlet sediments pose only a limited threat to marine life and seabirds preying on marine species. The ecological risk assessment did not confirm the need for remedial action. Some areas that have sediment concentrations of several key inorganic and organic chemicals exceeding the SQS and that are colocated or adjacent to areas with minor adverse bioassay results may be remediated as part of a human-health-based cleanup program. In these locations, an improvement in ecological health is expected.

The results of the baseline human health risk assessment indicate that potential long-term risks associated with fish tissue contamination in Sinclair Inlet are above acceptable levels defined under both the state (MTCA) and federal (Superfund) regulations. The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment. Consistent with the NCP, EPA policy, and MTCA, remedial action is warranted to address these potential risks.

9.2 REMEDIAL ACTION OBJECTIVES

Based on the risk assessment, the following remedial action objectives (RAO5) were developed for marine 0U B:

- Reduce the concentration of PCBs in sediments to below the minimum cleanup level (MCUL; defined in Section 9.3) in the biologically active zone (0-to 10-cm depth) within marine OU B, as a measure expected to reduce PCB concentrations in fish tissue
- Control shoreline erosion of contaminated fill material at Site 1
- Selectively remove sediment with high concentrations of mercury colocated with PCBs

9.3 MINIMUM CLEANUP LEVELS, ACTION LEVELS, AND LONG-TERM CLEANUP GOALS

This section describes the minimum cleanup levels, action levels, and long-term cleanup goals for the remedial alternative selected for marine OU B:

- The MCULs represent site-specific concentration limits to protect human health and the environment, conditioned by site-specific circumstances (e.g., sensitive habitats, engineering feasibility, and cost). Achievement of the MCUL in shallow sediment (0-to 10-cm depth) signals compliance with the first RAO listed above.

- Action levels are based on a number of factors described below and have been set to define areas of sediments for active remediation and to develop remedial action alternatives.

The concept of area-weighted averaging is widely used in sediment management and is integral to the following discussion. An area- weighted average sediment concentration is similar to a simple arithmetic average of the measured values, except that each individual measured value is weighted in proportion to the sediment area it represents.

The relationship of these criteria to one another and the way in which they are used to define elements of the remedial action (eg., active remediation and monitoring) are described in the following subsections.

9.3.1 Minimum Cleanup Levels (MCULs)

The primary measurable objective for the cleanup of PCBs in OU B sediments is the MCUL of 3 mg/kg OC, as defined by modeling results for natural recovery. The Washington State sediment management standards (SMS) define a reasonable timeframe for achieving cleanup levels as less than 10 years. The current area-weighted average concentration of PCBs in sediments within OU B is approximately 7.8 mg/kg OC. Immediately following cleanup and as a result of active remediation, the area-weighted average concentration of PCBs in sediments within OU B will decrease to approximately 4.1 mg/kg OC. Natural recovery is expected to further reduce PCB concentrations over time, primarily as a result of natural deposition of clean sediments that is occurring in Sinclair Inlet. Natural recovery modeling predicts that the MCUL of 3 mg/kg OC can be achieved within the 10-year timeframe. The assumptions used in the natural recovery modeling are documented in the administrative record.

Achievement of the MCUL signals compliance with the RAO to “reduce the concentration of PCBs in sediments to below the minimum cleanup level in the biologically active zone (0-to 10-cm depth).”

9.3.2 Action Levels

Action levels have been set to define areas of sediments for active remediation and to develop the remedial action alternatives. The action levels are summarized in Table 9-1. These action levels were developed based on consideration of the following factors:

- Whether the action levels will result in OU B sediments achieving established and anticipated sediment quality goals, considering the effects of natural recovery

- Whether the action levels are consistent with actions being contemplated for other marine sediment cleanups in the region

- Whether the action levels are cost effective, optimizing the reduction of risk for the money spent

- Whether implementation of cleanup actions at the action levels is practicable, considering the technical challenges of remediating large volumes of sediment

Action Levels for PUBs

Action levels for PCBs are based on the carbon-normalized total PCB concentrations in surface sediments (i.e., the sum of the concentrations of all PCB congeners, divided by the organic carbon concentration). Taking action to remediate sediments containing PCBs above a given action level will result in a reduction in the area- weighted average PCB concentrations in surface sediments. It is assumed that, over time, reductions in area- weighted average PCB concentrations in surface sediments will result in a corresponding decrease in both marine tissue PCB concentrations and the resultant predicted human health risk.

Development of action levels for dredging of PCBs in sediments included an analysis of the costs associated with the relative risk reduction that would be anticipated. The relative cost-effectiveness of dredging to successively lower action levels was defined as the incremental reduction in area-weighted average PCB concentrations divided by the incremental volume of sediment requiring dredging. The relative cost-effectiveness decreased significantly at PCB action levels below 14 mg/kg OC. A PCB action level of 12 mg/kg OC was selected to identify areas of sediment to be dredged, which provides a degree of conservatism below the cost-effectiveness threshold. The PCB action level of 12 mg/kg OC is consistent with the Washington State SQS criterion and generally falls within the range of other regional marine sediment cleanup actions.

Dredging and disposal is not considered cost-effective at PCB levels below 12 mg/kg OC. However, additional lower cost actions were considered to address areas of intermediate PCB concentrations and accomplish further risk reduction in response to resource agency concerns. A PCB action level of 6 mg/kg OC was selected to identify areas of sediment in which enhanced natural recovery actions would be considered (as accomplished by thin-layer capping). This action level is an intermediate value between the dredging action-level and reference-area concentrations and is consistent with criteria reportedly under consideration by resource agencies. However, as explained in Section 10, navigational requirements of the Naval Complex restrict the areas in which thin-layer capping can be implemented.

These action levels for PCBs are designed to address the areas in which remediation will provide the greatest reduction of risk for the money spent. Combined with incidental removal of PCBs accomplished by the planned navigational dredging and considering the effects of natural recovery, remediation of PCBs at these action levels is predicted to result in attainment of the MCUL of 3 mg/kg OC within 10 years.

Action Level for Mercury

The remedial action objective for mercury is to selectively remove sediments containing the highest concentrations of mercury that are colocated with elevated PCB concentrations. Existing mercury concentrations in sediments will be reduced as a result of remediating PCBs, because many of the areas of sediment with the highest mercury levels coincide with areas where PCBs exceed the remedial action levels. By focusing additional mercury remediation on areas containing elevated concentrations of both mercury and PCBs, the greatest overall risk reduction can be achieved.

The Navy, Ecology, and EPA selected a combined action level of 3 mg/kg mercury and 6 mg/kg OC PCBs to accomplish the remedial action objective for mercury. Applying this action level, sediment management units would be dredged in which mercury concentrations exceed 3 mg/ kg and PCB concentrations exceed 6 mg/kg OC. This action level was developed after analyzing the spatial distribution of both mercury and PCBs and considering the areas already targeted for cleanup as a result of the PCB action levels. This action level was based primarily on the practicability of remediating the additional volume of sediments. At lower action levels, constraints on access to dredging areas and limitations on the construction season for in-water work rendered the additional cleanup work impracticable.

Use of Action Levels in Developing Alternatives

Remedial alternatives were developed based on implementing the action levels, using the sample results within each sediment management unit. However, the need for active remediation within each specific sediment management unit is determined on a case-by-case basis by considering such practical factors as vessel moorage requirements, depth requirements in navigational areas, slope stability considerations, and safety issues. These considerations are discussed further in Section 10.

9.3.3 Cleanup Goals

MTCA establishes that if the risk-based cleanup goals are less than natural background, enforcement will be at the natural background level. MTCA acknowledges that some persistent organic compounds (e.g., PCBs) are found in surface soils and sediment throughout much of the state as a result of the global use of these substances.

Insufficient information was available to develop defensible risk-based cleanup goals within the timeframe of this early action ROD. Until such a risk-based goal can be developed the conservative approach of basing cleanup goals for both sediment and fish tissue on reference-area concentrations (i.e., natural background) has been adopted, consistent with MTCA. Use of reference-area concentrations is protective of human health, as this will result in no excess cancer risk, compared to background conditions, and no increased potential for noncarcinogenic health effects, compared to background conditions.

For PCBs in fish tissue (as represented by English sole), the cleanup goal is the reference-area concentration of 0.023 mg/kg wet weight. This reference- area concentration represents the 90th percentile concentration of PCBs in English sole collected from nonurban embayments.

For PCBs in Sinclair Inlet sediments, the cleanup goal is the reference-area concentration of 1.2 mg/kg OC, based on an area-weighted average. The reference-area concentration represents the 90th percentile concentration of PCBs in sediments collected from approved Puget Sound reference areas.

These long-term cleanup goals represent a conceptual target condition for all of Sinclair Inlet sediments and fish tissue and represent ideal “clean” conditions (i.e., no acute or chronic adverse biological effects and no significant human health threat). Monitoring of sediments and fish tissue will continue even if the RAOs are achieved until either of the cleanup goals is met, or the Navy, Ecology, and the EPA agree that the monitoring program is no longer providing useful information.

Table 9-2 presents the MCULs and cleanup goals for OU B. Remedial alternatives were developed for marine OU B with the objective of attaining these MCULs and contributing to meeting the cleanup goals.

Table 9-1
Action Levels for Marine OU B Sediments

Chemical of Concern	Response Action	Action Level a	Basis of Determination
PCBs	Dredging and disposal or in situ capping	>12 mg/kg OC PCBs	Relative risk reduction Sediment quality standard
PCBs	Enhanced natural recovery	>6 mg/kg OC PCBs	Resource agency concern and relative risk reduction
Mercury	Dredging and disposal	>6 mg/kg OC PCBs and >3 mg/kg mercury	Resource agency concern and practicability

a Exceptions are noted in Section 10.

Notes:
mg/kg OC - milligram per kilogram organic carbon
PCB - polychlorinated biphenyl

Table 9-2
Minimum Cleanup Levels and Long-Term Cleanup Goals for Marine OU B

Chemical of Concern	MCUL	Basis of Determination	Point of Compliance	Cleanup Goal	Basis of Determination	Point of Compliance
Sediments						
Total PCBs	3 mg/kg OC (based on the area-weighted average)	Natural recovery modeling	Biologically active zone (0 to 10 cm) marine OU B	1.2 mg/kg OC (based on the area-weighted average)	90th percentile of reference-area concentrations	Biologically active zone (0 to 10 cm) Sinclair Inlet
Fish Tissue						
Total PCBs	--	--	--	0.023 mg/kg wet weight	90th percentile of reference-area concentrations	English sole from Sinclair Inlet

Notes:
-- not applicable
cm - centimeter
MCUL - minimum cleanup level
mg/kg - milligram per kilogram
OC - organic carbon
PCB - polychlorinated biphenyl

10.0 DESCRIPTION OF ALTERNATIVES

10.1 BASIS FOR DEVELOPMENT OF ALTERNATIVES

This section describes the approach that has been taken to develop and evaluate a range of viable alternatives for remediation of marine sediments at OU B. Included is a brief discussion of the alternatives considered in the draft FS, a summary of key information obtained since publication of the draft FS, and a summary of how the list of alternatives has evolved as a result of the new information,

10.1.1 Alternatives Evaluated in the Draft Feasibility Study

The draft FS presents a broad spectrum of remedial technologies screened for potential applicability to the remediation of marine sediments at OU B. Based on evaluations of effectiveness, implementability, and cost, certain remedial technologies were eliminated and the remaining technologies were assembled into a range of remedial action alternatives. The remedial alternatives were developed in detail and evaluated using the nine CERCLA evaluation criteria. These alternatives were developed based on information available at the time the draft FS was published in April 1999. The alternatives were also developed to reflect discussions between the Navy and stakeholders during the FS workshops held between November 1998 and January 1999. For example, potential habitat implications of sediment disposal methods were noted for each alternative. Table 10-1 summarizes the alternatives considered in the draft FS. (The use of the prefix “SD” in denoting the individual sediment cleanup alternatives is the nomenclature used in the FS and adopted in this ROD. The proposed plan did not use the “SD” prefix, but the alternative numbers remain the same.)

10.1.2 Information Obtained Since the Draft Feasibility Study

Since publication of the draft FS, several investigations have been completed that have implications for the design of the sediment remedial alternatives. This information has resulted in a re-evaluation of the scope of, and the viability of, the sediment remedial alternatives presented in the draft FS. The alternatives described in this ROD have been revised to reflect the new information. These investigations are summarized below.

Stakeholder Workshops on Sediment Remediation

The workshops put on by the Navy between November 1998 and January 1999 to promote discussions between the Navy and others with a stake in the Sinclair Inlet ecosystem were quite successful in identifying a variety of preferences regarding potential sediment remediation. The Navy initially used these insights to upgrade the preliminary sediment remedial alternatives for analysis in the draft FS. Subsequent to the draft ES, a set of criteria developed during the workshops as a means of assessing and comparing the acceptability of alternative approaches to sediment cleanup was used to further refine the alternatives (see Table 10-2).

Nature and Extent of PCB-Contaminated Sediments

In the draft FS, all estimates of quantities and locations of sediments above the action level were based on an analysis of existing sediment chemistry data from the site inspection (SI) and RI. Additional sampling and analysis for PCBs was conducted in support of the ES in December 1998 through January 1999. This sampling was organized by using available historical PCB information to divide the area to be sampled into feasibility study sampling units (FSSU5). The results of the new nature and extent data were reported in a technical memorandum in June 1999. The following are the primary results of this investigation:

- The area in which surface sediments exceed the PCB action level is now estimated at approximately 25 acres, compared to the draft FS estimated area of approximately 50 acres. (Areas where surface sediments exceed the PCB action level are based on the new data shown in Figure 6-5.)
- Areas of sediment in the eastern portion of the Complex contain PCBs at concentrations of 6 to 12 mg/kg OC, as well as mercury at concentrations exceeding 3.0 mg/kg. The areas in which sediments contain elevated concentrations of both mercury and PCBs total approximately 7 acres.

- The depth of sediment impacted by PCBs is generally less than 3 feet, which is consistent with the assumption in the draft ES (results of borings showing the vertical extent of contamination are shown in Figure 6-6).

- Sediments impacted by PCBs extend to a greater depth in submerged nearshore fill areas near the Site 1 shoreline (based on results from core 1137, as shown in Figure 6-6). This was not accounted for in the draft ES, and special engineering measures are required for this area.

- One under-pier area (the seaward portion of Pier D) contains PCBs above the action level in surface sediments. It was assumed in the draft FS that no under-pier dredging would occur. This assumption is still valid, for the reasons described in Section 10.3.

Geotechnical Investigation of Sediments Offshore from OUA

In 1999, a series of deep borings (up to 142 feet deep) were taken from sediments offshore from Oh A in the area of the CAD facility and confined disposal facility (CDF) considered in the draft PS (Alternatives SD4 and SD6). Samples from these borings were analyzed to evaluate their physical and geotechnical properties. The results indicate that the native sediments in this area are a very soft mixture of clays and silt that extends to depths of31 to 136 feet below the mudline. The primary implications of these findings are:

- Construction of a containment berm in this area (as part of a CAD or CDF cell under draft PS Alternatives SD4 or 51) 6) would be much more difficult than anticipated in the FS. Extensive berm foundations and buttresses would be required, which would greatly increase the cost of these alternatives. Also, extended periods would be required for construction of the berm and to allow consolidation of underlying sediments. This would necessitate construction of the CAD or CDF over two or more construction seasons. (The in- water construction season is constrained by prohibited work times that are set by natural resource agencies to protect fish migration.) The extended construction schedule greatly reduces the implementability of these alternatives and would preclude integrating cleanup dredging with planned navigational dredging.

- The soft sediments offshore from OU A could easily be excavated for construction of an excavated CAD cell (or “pit CAD”). An assumption in the draft PS was that hard glacial till would be present in this area, and therefore the excavated CAD under Draft PS alternatives 5A and 5B to be located in the western portion of Sinclair Inlet, on State-owned aquatic land. The existence of deep, soft sediments offshore from OU A makes it possible to construct one or more excavated CAD cells entirely on Navy-owned aquatic land.

- The results of the physical properties tests indicate that it would be difficult to beneficially use excavated clean sediments from an excavated CAD cell in the manner described in draft FS Alternative SDSB. Alternative SD5B assumed that a shoreline softening structure with a sloped surface could be built along the north shoreline of Sinclair Inlet using clean sediments from an excavated CAD cell. A sloped surface at intertidal elevations is a critical requirement for habitat restoration. The physical properties of these sediments makes it difficult to use them to construct a shoreline softening structure with a sloping surface as envisioned in the PS, and the risk of failure of such a structure would be high.

Physical Properties of Contaminated Sediments and Contaminant Mobility

In 1999, the Navy completed testing to evaluate the engineering properties of dredged contaminated sediments and the potential for contaminant transport that may result from dredging and disposal of the sediments. The following are the primary results of this investigation:

- Surface sediments to be dredged can physically be characterized as soft organic silts with high water content. The results of the physical properties tests indicate that it would be difficult to construct a confined aquatic disposal (CAD) cell with a sloping surface and that the risk of failure of a CAD cell with a sloped cap would be high. It was assumed in the draft FS that the nearshore CAD cell under — Alternative SD4 would have a sloping cap for habitat enhancement, which is no longer considered a viable design element.

- Short- term water quality impacts at the point of dredging and at the point of disposal were evaluated using the dredge elutriate test, the standard elutriate test, and associated modeling. The impacts were generally found to be minor. This information will be used in the remedial design to verify that water quality requirements are met at designated points of compliance (e. g., outside of a designated mixing zone) and to evaluate the need for any specific control measures during dredging and disposal.

- Long-term water quality impacts at the point of disposal were evaluated using the results of the thin- layer column leach test. Associated chemical transport modeling indicates that long- term transport of chemicals from an excavated CAD cell constructed offshore of OU A would not result in any exceedances of water quality criteria.

Chemical Characterization of Sediments Offshore from OUA4

In 1999, the Navy began characterization of sediments offshore from OU A, in the newly proposed location of an excavated CAD cell. The purpose of the characterization was to determine if sediments excavated from this area would be suitable for open water disposal at a Dredged Material Management Program (DMMP) disposal site and/or for beneficial use. The testing protocol included both chemical and biological toxicity tests as required by the DMMP agencies. The results of this testing program were as follows:

- All sediments deeper than 3 feet below the mudline pass the DMMP characterization criteria and would be suitable for open water disposal and/or beneficial use.

- Approximately 4,000 cubic yards of the surface sediments (0 to 3 feet in depth) fail the DMMP biological characterization criteria and are not suitable for open water disposal or beneficial use.

Engineering Evaluation of Site I Shoreline

Sediments impacted by PCBs extend to depths greater than 3 feet below the mudline in the submerged nearshore fill areas at Site 1. This is a steep sloping shoreline area consisting of recently deposited (since 1945) submerged fill that contains anthropogenic debris (Figure 10-I). The southern and eastern shoreline in this area is armored with riprap, which extends down to about 0 feet MLLW. Below the riprap, the shoreline is an unarmored fill slope that abruptly drops off to a depth of approximately —40 feet MLLW. Based on the sediment boring results from this area, it is concluded that any dredging of the surface layer of the nearshore fill is likely to expose more contaminated fill, and may potentially undermine the existing riprap protection along the shoreline. Further, navigational requirements in this area may necessitate future dredging that could expose more contaminated fill and undermine the existing riprap protection.

In the draft FS, enhanced riprap protection for Site 1 was considered under Alternative 6W4. Because any future shoreline erosion or navigational dredging at Site 1 would have the potential to re-contaminate the marine environment, and because of logistical considerations regarding vessel movement during the remediation, shoreline protection actions for Site I will be addressed in this ROD in conjunction with sediment remedial actions in nearshore areas.

A range of engineering approaches was evaluated to contain and isolate the eroding fill materials, improve slope stability, and accommodate future navigational requirements in the Site I area. Additional analysis of slope stability in this area indicates that dredging that is designed to accommodate the future navigational requirements on the south portion of the Site I shoreline would result in potentially unstable conditions. Therefore, specific engineered measures are required on the south portion of the Site 1 shoreline to improve slope stability. The cleanup actions for Site I will necessarily include some combination of dredging and capping actions on the lower portions of the slope, measures to improve slope stability, and enhanced riprap protection on the upper portions of the slope.

Mercury Occurrence in Rockfish Tissue

As explained in Section 9, additional information has become available indicating that mercury levels in rockfish tend to be higher than those measured in English sole. Sediments containing elevated mercury concentrations may be a source of the mercury found in rockfish. Many of the areas of sediment with the highest mercury levels coincide with areas where PCBs exceed the remedial action level of 12 mg/kg OC. To further reduce both mercury and PCB concentrations in sediments of the inlet, several additional locations with mercury concentrations above 3 mg/kg and PCBs between 6 and 12 mg/kg OC have been included in the dredging components of the alternatives.

10.1.3 Alternatives Remaining for Consideration

Based on the comparative analysis of the marine sediment alternatives in the draft FS, and with consideration of the new information gathered since the Draft FS was published, it has been determined that several of the alternatives are not feasible. Alternatives no longer considered feasible because their implementation would be difficult are not discussed in detail in this ROD. Table 10- 3 summarizes the rationale for excluding some of the alternatives and summarizes key modifications to the alternatives that remain. The remaining alternatives are:

- Alternative SD1— No Action
- Alternative SD2— Dredging with Upland Landfill Disposal
- Alternative SD7— Dredging with Excavated Confined Aquatic Disposal

Alternative 5D7 was not described in the draft FS— it is a variation of Alternative SD5A, with the excavated CAD cell constructed on Navy- owned property instead of State-owned property.

The following subsections describe the specific components of the alternatives, quantity estimates, cost estimates, and the engineering assumptions that were used to define the scope of the actions.

10.2 ALTERNATIVE SD1—NO ACTION

Alternative SD1—No Action is included to provide a basis from which to compare the cost effectiveness of other alternatives. This inclusion helps ensure that the consequences of no action are filly evaluated and that instances in which no action may be appropriate are fully recognized, so that needless remediation expenses can be avoided when only marginal benefits are expected.

Under this alternative, no proactive measures would be undertaken to remediate concentrations of COCs, and no institutional controls would be imposed to reduce or prevent human exposure.

Additional risk reduction and migration control for COCs would occur through natural recovery mechanisms, primarily mixing and burial caused by deposition of clean sediments. This alternative would not include environmental monitoring to assess the effectiveness of natural attenuation, or to verify protection of human health or the environment.

10.3 ALTERNATIVE SD2—DREDGING WITH UPLAND LANDFILL DISPOSAL

10.3.1 Description of Alternative

The primary objective of Alternative SD2 is to remove from the marine environment those sediments with contaminant concentrations greater than the remedial action level. The dredged CERCLA sediments would be transported upland and placed in a permitted Resource Conservation and Recovery Act (RCRA) landfill. This alternative assumes that at all navigational sediments would be handled independently and would not affect the CERCLA remediation.

Alternative SD2 includes the following components:

- Dredging of sediments
- Dewatering and transport of sediments
- Disposal in a permitted RCRA landfill
- Enhanced natural recovery
- In situ capping
- Shoreline stabilization at Site I
- Monitoring
- Institutional controls
- Maintenance
- Periodic reviews

10.3.2 Dredging of Sediments

Dredging Locations and Volumes

Sediments with PCB concentrations greater than the remedial action level of 12 mg/kg OC would be removed by dredging. To address elevated mercury concentrations, sediments would also be dredged in areas where mercury concentrations exceed 3.0 mg/kg and PCB concentrations exceed 6 mg/kg OC. The determination of the specific areas to be dredged is based on the CERCLA FSSUs that have been independently characterized by chemical analyses. The conceptual design for dredging is shown in Figure 10-2. The combined area of sediments to be dredged is approximately 32 acres.

The depth of sediments containing PCBs and mercury is approximately 1 to 2 feet. Therefore, a minimum of 2 feet of sediment would be dredged from the designated areas. In offshore areas with relatively flat bathymetric profiles, overdredging to an average 1-foot over depth is assumed. However, in nearshore areas, the mudlines are often steep slopes which require “stair-step” dredge profiles. A greater amount of overdredging is required to accomplish the nearshore dredge profiles. For cost estimating purposes, the volume of impacted sediments to be dredged for environmental remediation is estimated at 200,000 in-place cubic yards.

A dredge plan would be prepared as part of the remedial design to specify the designated dredging areas. The intent of the remedial design would be to remove the majority of sediments with chemical concentrations greater than the remedial action levels. However, practical constraints such as vessel moorage requirements, slope stability considerations, and safety issues would be taken into account during the remedial design, and alternative FSSUs may be dredged to accomplish a similar reduction in area-weighted average PCB concentrations. As indicated below, there are some instances in which the FSSUs targeted for dredging do not exactly correspond to the areas exceeding the remedial action level:

- **FSSU F15 would be dredged instead of F25.** This substitution is based on logistical considerations of the dredging operations and cost. FSSU F15 would be readily accessible when two adjacent FSSUs (F13 and F16) are being dredged, whereas FSSU F25 will be inaccessible because of moored vessels. Relocation of these vessels would cost approximately $100,000. The PCB concentrations in sediments from F15 and F25 are similar (10.6 mg/ kg OC and 14.6 mg/ kg OC, respectively), and thus the risk reduction would be similar.

- **Under-pier sediments would not be dredged**. Only one under-pier area (the seaward portion of Pier D) contains PCBs above 12 mg/ kg OC in surface sediments. This area will not be accessible to a clamshell dredge; a specialty diver-operated hydraulic dredge would be required. The technical feasibility and effectiveness of these methods are uncertain. This approach would entrain large quantities of water and would require special handling of the sediments, further increasing the cost and potential risk compared to open-water dredging. Because this is believed to be a depositional area, conditions are expected to gradually improve as a result of natural recovery processes. Removal of these sediments would not appreciably reduce the potential area- weighted average exposure to PCBs of marine life such as English sole. Because the short-term risks to divers are considered to exceed any long- term risk reduction that could be accomplished by under-pier dredging, no such dredging is planned. All of marine OU B, including under-pier sediments, will be included in the long-term monitoring program.

- **Sediments in nearshore locations at OU A would not be dredged**. In the nearshore area of OU A, three FSSUs (P3, F4, and F6) contain PCBs above the remedial action level in surface sediments. Because this area is outside of the navigational channels, thick-layer capping of the sediments is a viable technology that can achieve the same risk reduction as dredging and disposal. The in situ capping of these sediments is described in a following subsection.

The conceptual dredge design shown in Figure 10-2 may be modified during the remedial design as more information on logistical constraints becomes available.

Coordination with Navigational Dredging

The planned navigational dredging project is anticipated to remove approximately 370,000 cubic yards of sediment. Based on chemical and biological testing, approximately 100,000 cubic yards of the sediments from the navigational dredging project are unsuitable for open- water disposal. Because of implementation and coordination constraints, this alternative assumes that the dredging and disposal of the navigational sediments would be accomplished independently of the CERCLA remediation.

Dredge Equipment and Scheduling

Equipment process options for dredging include mechanical, hydraulic, and specialty configurations. Mechanical dredging with a clamshell bucket is the preferred process option because it results in minimal resuspension of contaminated sediments and minimizes the water content of the dredge spoils. Both open clamshells and closed clamshells are available. Closed clamshells can reduce the amount of sediment resuspended, but also may entrain more water in the dredge spoils. The selection of mechanical dredging buckets would be accomplished in the remedial design.

The mechanically dredged sediments would be placed onto an adjacent barge for rehandling and dewatering. Details on the rehandling and dewatering process are discussed in the subsections below.

To the extent practicable, dredging would be implemented so as not to interfere with the navigational requirements of Navy vessels, ferries, or commercial and tribal vessels, as well as Navy moorage requirements. To allow dredging access, temporary relocation of Navy vessels from affected piers would need to be scheduled. As discussed previously, the dredge design may be modified during the remedial design as a result of logistical considerations. Scheduling and coordination of the dredging with Navy operational requirements is a major concern under Alternative SD2. Under Alternative SD2, it is assumed that the navigational dredging would proceed in the summer of 2000 construction season, and that the unsuitable navigational dredged material would be disposed of in an upland landfill. The logistical constraints of dewatering, rehandling and transporting the navigational material are expected to preclude the Navy from undertaking the CERCLA cleanup during the summer of 2000 construction season. The Pier D reconstruction project would eliminate additional moorage and potentially delay the implementation of Alternative SD2 for several years.

Water Quality Impacts

The dredge plan would specify requirements for bathymetry surveys and short- term water quality monitoring during dredging. The water column would be monitored during dredging to ensure that water quality criteria are not exceeded outside the immediate construction zone. Key monitoring parameters are dissolved oxygen, turbidity, and total suspended solids (TSS) though measurement of additional water quality parameters may be required. A dilution zone (outside of which the water quality parameters must be met) would be defined in the dredge plan, upon consultation with Ecology and EPA.

Contaminant losses at the point of dredging, and subsequent water quality impacts, have been estimated using the results of a dredge elutriate test and predictive mathematical models. The modeling results would be used in the remedial design to define the required monitoring parameters, dilution zones, and the need for mitigating measures such as closed-bucket operational controls and then, if necessary, silt curtains.

10.3.3 Dewatering and Transport of Sediments

Dredged sediments targeted for off-site disposal would be required to contain no free liquids when they are placed in a RCRA Subtitle D landfill. The acceptance criterion for this requirement is the paint filter test. Tests of sediment core samples have indicated that in one case sediments pass the paint filter test and that in another case they fail. Because the actual dredging operation is expected to entrain more water than the coring methods used in the above studies, it is expected that the dredged sediments would fail the paint filter test. Thus, dewatering of the sediments or addition of amendments, such as Portland cement, fly ash, or lime would be required for upland disposal.

Dewatering technologies can be divided into two general processes: air drying and mechanical processes.

- Air drying refers to those dewatering techniques by which the moisture is removed by natural evaporation and gravity, or by induced drainage. Air drying is typically less complex, easier to operate, and requires less energy than mechanical dewatering. However, air drying requires a larger land area and its effectiveness can be affected by the weather. In 1994 and 1995, approximately 50,000 cubic yards of unsuitable dredged material from Pier 0 navigational dredging was dewatered in the helipad area of OU A. Reportedly this technique had only limited success in removing sufficient moisture from the sediments, and there were significant logistical problems associated with handling the sediments in a limited area, It is possible that successful application of air drying for dredged sediments at OU B would require an induced drainage technique, such as a vacuum underdrain system. Vacuum underdrain systems have been reported to improve dewatering efficiencies by 50 percent, but they require considerable maintenance and supervision. Even if a vacuum underdrain system significantly decreased the time required for dewatering compared to gravity drainage, space constraints could necessitate on-barge dewatering.

- Mechanical dewatering involves processes in which water is forced out of the sediment through mechanically induced pressures. The most common and applicable mechanical dewatering technology is the belt filter press. Belt filter presses operate continuously and do not take as large an area as the air drying process. While it would be effective, use of a belt filter press would be a relatively expensive option, with treatment costs on the order of$ 25 per cubic yard.

The dewatering and rehandling site would be outfitted with berms to contain and collect dewatering liquids and runoff. Liquids generated from the dewatering process may require treatment to reduce turbidity and potentially to attain water quality criteria for chemical constituents. The results of the contaminant mobility testing would be used to determine the need for and type of treatment.

Transport of dewatered or amended sediments could be accomplished by rail, barge, trucks, or a combination of these. Rail transport is preferred under this alternative, because it is generally less expensive; however, disposal site selection would affect the selection of transport methods.

The exact configuration of the materials handling and transportation processes would be determined in the remedial design. For cost estimating purposes, it was assumed that the dredged sediments would be stabilized by the addition of amendments and transported by rail to the disposal site.

10.3.4 Disposal in a RCRA Landfill

The dewatered sediments would be transported to a permitted RCR. A Subtitle D landfill. The FS cost estimate assumed transport by rail and disposal at a facility in Eastern Washington. Actual disposal site selection would occur during the remedial design.

10.3.5 Enhanced Natural Recovery

Mathematical modeling was conducted as part of the RI to evaluate the potential for natural recovery of contaminated sediments within Sinclair Inlet and OU B. The average sedimentation rate for Sinclair Inlet is approximately 0.5 to 0.75 cm/year, and incoming sediments contain relatively low PCB concentrations (approximately 0.89 mg/kg OC), The results of the modeling indicate that, over time, a significant reduction is expected in the PCB concentrations in Sinclair Inlet surface sediments. Combined with the dredging and disposal actions, natural recovery is expected to reduce the marine OU B area-weighted average PCB concentrations to below the minimum cleanup level (MCUL) of 3 mg/kg OC within 10 years and to below the cleanup goal of 1.2 mg/kg OC within approximately 30 years throughout the inlet.

To further accelerate this natural recovery, additional clean sediment would be placed in specific areas in Sinclair Inlet. Enhanced natural recovery would be employed in select areas with current PCB concentrations below the dredging action level (12 mg/kg OC) but above 6 mg/kg OC. (Areas in which enhanced natural recovery can be implemented are limited by navigational requirements of the Navy, as discussed below.) Enhanced natural recovery would be accomplished by thin- layer capping. With this approach, a thin layer of about 10 to 20 cm of clean sediments is placed over the in- place contaminated sediments. This layer is not intended to provide a complete “seal” over the bottom as in a normal capping operation. Instead, the thin-layer cap provides a layer of clean sediment in which existing organisms establish themselves. This reduces the contaminant concentrations to which the organisms are exposed, minimizes short-term disruption of the benthic community, and effectively accelerates the effects of natural sediment deposition.

A thin-layer cap would raise the bottom elevation by approximately 10 to 20 cm and potentially interfere with present or potential future navigational requirements of deep-draft vessels at the BNC. Because of this land use constraint, a thin- layer cap cannot be implemented within the navigation channels.

The thin-layer cap would cover approximately 78,000 square yards, in the area shown in Figure 10-2. Assuming a 50 percent volume contingency for overlap and consolidation, a total of 20,000 cubic yards of borrow material would be required for the thin-layer cap. Placement of the borrow material is typically accomplished by positioning a split-hulled hopper barge over the target area, opening the hull, and allowing a controlled release of the sediment as the barge is towed across the site. This produces a long, low-relief ridge of cap material along the bottom. Subsequent barges are positioned to place another ridge adjacent to the first, so that the toes of the ridges meet to form a continuous cap. Alternatively, the capping material can be placed mechanically, using a clamshell bucket.

Sands are usually preferred for capping material because of their ease of placement and cap stability. Since risk reduction occurs by reducing the carbon-normalized concentration of PCBs, the imported clean sediments must have a significant organic carbon content. Identification of an actual borrow source would be accomplished during the remedial design. One possible on-site source of clean sediments is the suitable navigational sediments; however, this would be subject to severe scheduling constraints. Further, the suitable navigational sediments are partially consolidated silts and clays, which could cause difficulty in cap placement, turbidity concerns, and resuspension and cap stability concerns. A likely off-site source is the periodic U. S. Army Corps of Engineers maintenance dredging operations. These sources would require considerable attention so that the timing of the OU B project coincides with the availability of the capping material. However, the enhanced natural attenuation actions could be scheduled independently of the dredging and disposal actions. The costs to dredge any of these potential sources of clean sediment are assumed to be incurred as part of other dredging projects. It is possible that a fee would be levied against any material diverted from a disposal site operated by the Washington State Department of Natural Resources.

To the extent practicable, transportation and placement of the clean sediments would be implemented so as not to interfere with the navigational requirements of Navy vessels, ferries, or commercial and tribal vessels, as well as Navy moorage requirements. The water column would be monitored during sediment placement to verify that water quality criteria are not exceeded outside the immediate zone of construction. For cost estimating purposes it has been assumed that silt curtains would not be required for turbidity control during placement of the clean sediments.

Because the identified area for thin-layer capping is outside the Navy’s navigation lanes, propeller wash is not expected to resuspend the capping material to a significant extent. Sediments placed for enhanced natural attenuation are intended to dilute the contaminant concentrations in surface sediments (rather than to isolate the contaminants). To the extent that any sediments are resuspended and transported from the capped area, the overall effect would be to enhance the mixing and dilution processes in other areas.

10.3.6 In Situ Capping

In the nearshore area of OU A, FSSUs P3, F4, and F6 contain PCBs above the remedial action level in surface sediments. Because this area is outside of the navigational channels, thick-layer capping of the sediments is a viable technology that can achieve the same risk reduction as dredging and disposal. No future navigational activities are expected that may disturb a cap.

The in situ capping of these sediments would consist of placing a nominal 3-foot-thick layer of imported material over the existing sediments. The intent of the cap would be to permanently contain the affected sediments and limit their availability to marine organisms. An estimated 8,000 cubic yards of borrow material would be required for the cap. The cap would be armored as needed to withstand erosional forces. Identification of suitable borrow material, and placement of the material to form the cap, would generally be similar to the thin-layer capping procedures described previously. Specific material(s) and thickness(es) of the cap would be determined in the remedial design, using EPA guidance for in situ capping of contaminated sediments.

Previous shoreline construction has been implemented in this area as part of the selected remedy for OU A. The OU A shoreline remedy extends up to 100 feet seaward of the shoreline and already covers significant portions of FSSUs F3 and F6. The cap in this area would not extend over the existing OU A shoreline remedy. The areas of capping and the existing OU A shoreline remedy are shown in Figure 10-2.

10.3.7 Shoreline Stabilization at Site 1

Cleanup actions at Site I would include a combination of enhanced riprap protection on the shoreline (i.e., on the upper portions of the fill slope), dredging and capping actions in offshore sediments (i.e., on the lower portions of the fill slope), and measures to improve slope stability. These actions would be designed to achieve the following performance criteria:

- Minimize human and ecological exposure to eroding fill materials
- Improve slope stability to minimize the potential for future sloughing or erosion
- Accommodate future navigational requirements
- Withstand a prescribed design storm event
- Limit encroachment into the marine environment

Figure 10-3 shows conceptual approaches that may be used to accomplish these objectives. Design specifics would be refined in the remedial design.

Enhanced riprap protection would involve importing approximately 2,000 cubic yards of riprap material and placing it over existing riprap. Approximately 1,100 feet of shoreline at Site 1 would be affected. The riprap would extend from elevations of approximately -5 to +18 MLLW.

The Navy has long-range plans to deepen the Mooring Alpha area south of Site I, to accommodate moorage of inactivated submarines. This deepening project would require dredging into potentially contaminated fill material and could compromise the integrity of the enhanced riprap protection actions. For this reason, the CERCLA cleanup on the south slope of Site I would be designed to eliminate the need for future disturbances of the fill material and improve slope stability.

On the south shoreline of Site 1, dredging would occur below the bottom elevation of the new riprap (i.e., below approximately —5 MLLW). The dredge cuts would be designed to achieve slopes and elevations sufficient to accommodate future Mooring Alpha navigational requirements. The dredged face of the fill slope would be capped with imported material to contain any contamination that remains in the existing fill. An engineering evaluation indicates that the resulting slope on the south shore of Site 1 will not be stable without reinforcement. Slope stabilization measures such as driven sheet piles would be used as needed to strengthen the slope and minimize the potential for sloughing.

On the east side of Site 1, dredging would be limited to the eastern portion of FSSU FS8, where the mudline is relatively flat. On the sloping fill surface, a minimum 3- foot- thick capping layer of imported material would be placed below the bottom elevation of the new riprap (i.e., below approximately -5 MLLW) to contain any contamination that remains in the existing fill.

The erosion control measures would be maintained to minimize future releases of contaminated fill. The need for any corrective actions or physical maintenance would be identified by review of the monitoring results, discussed below.

10.3.8 Monitoring

Monitoring during implementation of the remedial actions would be conducted to assess short-term environmental effects and to confirm compliance with the remedial design. This compliance monitoring would consist of water quality monitoring, bathymetric surveys, and limited sediment chemical analysis.

Following cleanup, physical, chemical, and biological monitoring would continue as long as necessary. For cost estimating purposes, monitoring was assumed to continue for 30 years and include chemical and biological monitoring of sediments, tissue sampling, and physical surveys. Monitoring results would be documented for the periodic reviews discussed below. The specific numbers and types of samples, sampling frequency, and analytical methods could be adjusted in subsequent years after the 5- year review based on the results of the monitoring.

Specific requirements of the monitoring program are discussed in Section 12 of this ROD.

10.3.9 Institutional Controls

Using the data collected from the marine tissue monitoring program and other available information, the Washington State Department of Health and the Suquamish Tribe would decide the need for any restrictions on seafood harvesting in Sinclair Inlet.

Permanent land use restrictions would be placed on the property by the Navy. These restrictions would include the following:

- Special controls on activities that may disturb the submerged fill material at Site 1. These requirements may include health and safety plans, waste management plans, and environmental protection plans.
- Requirements for monitoring and maintaining the integrity of the shoreline stabilization measures

The Navy would administer the land use restrictions for as long as it owns the property. Future cleanup, if undertaken, could reduce the need for, or scope of, the land use restrictions.

Absent further cleanup, in the event of transfer of the property, it would be necessary to include deed or use restrictions. Deed restrictions cannot be placed on the property until property transfer. Upon property transfer, notification of the history of the site would be attached to any property transfer and the property transfer would have to meet the requirements of CERCLA Section 120(h).

Specific institutional control requirements are discussed in Section 12 of this ROD.

10.3.10 Maintenance

The shoreline stabilization actions would be designed to minimize the need for any maintenance. However, there is still some potential for damage by storms or seismic events. The need for any maintenance or repairs would be determined by the results of the monitoring program. The cost estimate includes nominal costs for physical maintenance of the shoreline stabilization measures.

10.3.11 Periodic Reviews

Because this alternative may result in some exceedances of state cleanup levels remaining in sediments, a periodic review of the monitoring program data would be required no less frequently than every 5 years. The monitoring data would be used by EPA, Ecology, and the Navy to ensure that the alternative remains protective of human health and the environment.

10.4 ALTERNATIVE SD7—DREDGING WITH EXCAVATED CONFINED AQUATIC DISPOSAL

Description of Alternative

The primary objective of Alternative SD7 is to consolidate and contain marine sediments with contaminant concentrations greater than the remedial action level. Alternative SD7 includes provisions for concurrent management of navigational sediments that are not suitable for open water disposal. All dredged CERCLA sediments and the unsuitable navigational sediments would be consolidated and placed in an excavated CAD facility located within OU B.

Alternative SD7 includes the following components:

- Dredging of sediments
- Confined aquatic disposal of CERCLA sediments and unsuitable navigational sediments in one or more excavated cells
- Enhanced natural recovery
- In situ capping

- Habitat restoration
- Shoreline stabilization at Site 1
- Monitoring
- Institutional controls
- Maintenance
- Periodic reviews

10.4.1 Dredging of Sediments

An estimated 200,000 cubic yards of contaminated CERCLA sediments would be dredged, as described in Alternative SD2. The dredging activities would be coordinated with the navigational dredging program. Disposal of the unsuitable material from the navigational dredging project would be included as part of this CERCLA action.

10.4.2 Confined Aquatic Disposal

Cell Location

One or more excavated CAD cells would be constructed within OU B, in the approximate location shown in Figure 10-4. The location was selected based on land ownership by the Navy, proximity to the dredging areas, location outside of the navigation channels, and presence of a deep accumulation of soft fine-grained sediments.

Conceptual Cell Design

The excavated CAD would consist of one or more pits excavated into the native sediments, to create cells into which the contaminated sediments would be placed. The pits would be sized to hold the expected quantities of both CERCLA and unsuitable navigational sediments. After receiving the contaminated sediments, the pits would be capped and finished to approximate the original bottom contours. The cell(s) would occupy approximately 10 acres of submerged land.

The proposed conceptual design for the offshore CAD cells is shown in cross section in Figure 10- 5. This conceptual design is based on the following design parameters:

- A deep accumulation of soft, fine grained sediments exists in this area that can readily be excavated to the desired depth (at least 30 feet below the mudline).
- Sidewall slopes are estimated at 3H: lv for stability.
- Subsurface sediments from the pit area have been characterized as suitable for open water disposal. Approximately 4,000 cubic yards of the surface sediments from the pit area are not suitable for open water disposal.
- Imported sand would be placed in a nominal 3-foot-thick layer as a cap to contain the contaminated sediments. A 1-foot-thick (nominal) layer of native sediments would be placed over the sand cap as a finishing layer to accelerate recolonization of the benthic community.

The cell would be sized to accommodate dredged material that may require disposal. This includes an estimated 200,000 cubic yards of CERCLA sediments and 100,000 cubic yards of unsuitable navigational sediments. The final volume will account for the final design quantity estimates of CERCLA and navigational sediments, anticipated bulking of the sediments, and the volume of capping materials that will be required. Management of the excavated material is discussed below.

Placement of Dredged Material

Mechanically dredged CERCLA and unsuitable navigational sediments would be delivered to the excavated CAD cell by bottom- dump haul barges and placed by instantaneous discharge in accordance with a prepared disposal plan. As with the dredging operations, the disposal plan would specify bathymetry surveys and water quality monitoring requirements during placement of dredged material into the CAD cell.

Contaminant losses at the point of disposal, and subsequent water quality impacts, have been estimated using the results of elutriate testing and predictive mathematical models. The modeling results would be used in the remedial design to define the required monitoring parameters, dilution zones, and the need for mitigating measures such as operational controls.

Final Cap

The final cap would consist of a nominal 3-foot-thick layer of imported sand, topped with a nominal 1-foot-thick layer of clean native sediments. During CAD cell excavation, an estimated 14,000 cubic yards of clean native sediments from the CAD cell excavation would be stockpiled on the bottom of Sinclair Inlet next to the pit for future use as a finishing layer. The stockpile would be maintained at a suitable slope to prevent sloughing.

Some time may be allowed after dredged material deposition to allow consolidation of the contaminated sediments. After this period, the capping layer of imported sand would be placed.

The sand cap may be placed in one or more lifts, with suitable consolidation periods between placement of the lifts. After the final sand layer is in place, the stockpiled sediments would be re-dredged and placed as the final cap layer.

Specific design elements of the cap may be modified in the remedial design, including required consolidation periods, modifications to the required cap thickness, or the need for importing additional capping material such as gravels or sands. Such changes would be considered to account for desired permeability, to provide armoring against anchor damage, to improve constructibility, or to provide habitat enhancement. Cap placement techniques would also be determined in the remedial design.

Management of Sediments from CAD Cell Excavation

Disposition of the excavated material from the CAD cell construction would include the following elements.

- **Disposal of surface sediments within CAD cells**. Approximately 4,000 cubic yards of surface sediments from the CAD cell area would be unsuitable for open water disposal. If the final design of the CAD cell includes excavation of the unsuitable material, it would be disposed of within one or more of the CAD cells.

- **Final cap at the CAD cell**. An estimated 14,000 cubic yards of clean sediments from the CAD cell excavation would be stockpiled on the bottom of Sinclair Inlet next to the pit, and used as a final capping layer over the backfilled CAD cell.

- **Source material for enhanced natural recovery and in situ capping**. An estimated 30,000 cubic yards of clean sediments from the CAD cell excavation would be used as a source material to accomplish enhanced natural recovery and in situ capping.

- **Beneficial use in habitat restoration**. Approximately 30,000 cubic yards of clean sediments may be used in areas offshore from OU A to create a more gentle slope near the shoreline and restore habitat. This volume of material would effectively be used to increase the thickness of the thin-layer and thick-layer caps near the OU A shoreline. The final contours of the capping/habitat enhancement measures would be determined in the remedial design. These actions are discussed later in Section 10.4.5.

- **Disposal of excess clean sediments at a DMMP site**. Any clean sediments that could not be used for the above purposes or other beneficial use would be placed in an acceptable disposal site, such as the Elliott Bay DMI\4P site.

10.4.3 Enhanced Natural Recovery

Enhanced natural recovery (thin-layer capping) would be implemented as generally described in

Alternative SD2, to address sediments containing PCBs in the 6 to 12 mg/kg OC range. Under Alternative SD7, the construction of the excavated CAD would generate clean sediments that could potentially be used to accomplish the enhanced natural recovery. For cost estimating purposes, it is assumed that the clean sediments obtained from the CAD cell excavation would have acceptable properties for this purpose. To provide smooth transitions in cap contours and to accomplish the habitat restoration (described below), the thickness of the thin-layer cap may be increased in some areas. It is noted that the partially consolidated fine-grained sediments from the CAD excavation could be difficult to place at a uniform thickness. Turbidity may also be difficult to control when placing this material.

10.4.4 In Situ Capping

The in situ capping measures would be implemented for specific areas offshore from OU A, as generally described in Alternative SD2. Under Alternative SD7, the construction of the excavated CAD would generate clean sediments that could potentially be used for cap construction. For cost estimating purposes, it is assumed that the clean sediments obtained from the CAD cell excavation would have acceptable properties for this purpose.

10.4.5 Habitat Restoration

The in situ capping and enhanced natural recovery actions under Alternative SD7 may be modified to include placement of sediments or other imported materials to create a gently sloping intertidal and subtidal area in the interests of restoring more natural conditions and improved fish habitat. These actions would occur in nearshore areas south of the existing OU A shoreline remedy. The intent of placing this additional material is to offset and satisfy Suquamish Tribal concerns about the pit CAD construction and operation. Approximately 30,000 cubic yards of material would be required for the habitat restoration. At intertidal elevations, a one-foot layer of imported gravel mix with the appropriate particle sizes for habitat enhancement could be added to the shoreline. The locations of the habitat restoration actions are shown in Figure 10-4. Figure 10-5 depicts the conceptual approach for the habitat restoration. Design specifics such as slopes, elevations, and materials selection will be determined in the remedial design.

The design approaches for habitat restoration are limited by the physical properties of both the existing bottom sediments in the OU A area and the clean sediments that would be imported from the CAD excavation. Consolidation properties and low shear strength diminish the engineering feasibility of constructing the types of structures considered in draft FS Alternative SD5B. The approach depicted in Figure 10-5 is considered feasible, given the physical constraints. Design specifics such as slopes, elevations, and materials selection would be determined in the remedial design.

10.4.6 Shoreline Stabilization at Site 1

The shoreline stabilization measures at Site I would be implemented as described in Alternative SD2.

10.4.7 Monitoring

Alternative SD7 would include all of the monitoring requirements of Alternative SD2, plus additional monitoring requirements associated with the CAD cells. For cost estimating purposes, monitoring requirements associated with the CAD cells were developed using Ecology guidelines and are assumed to include physical surveys as well as chemical and biological testing.

The monitoring would continue for as long as necessary. Monitoring results would be documented for the periodic reviews discussed below. The specific numbers and types of samples, sampling frequency, and analytical methods could be adjusted in subsequent years after the 5-year review based on the results of the monitoring.

Specific requirements of the monitoring program are discussed in Section 12 of this ROD.

10.4.8 Institutional Controls

The data collected from the marine tissue monitoring program would be evaluated for human health risk. Using these results and other available information, the Washington State Department of Health and the Suquamish Tribe would decide the need for any restrictions on seafood harvesting in Sinclair Inlet.

Permanent land use restrictions would be placed on the property by the Navy. These restrictions would include the following:

- Special controls would be placed on activities that may disturb the submerged fill material at Site I. These requirements may include health and safety plans, waste management plans, and environmental protection plans.

- Requirements would be issued for monitoring and maintaining the integrity of the shoreline stabilization measures.

- Special controls would be placed on activities that may disturb CAD cells. These requirements may include access restrictions, vessel size limitations, or a notice to mariners.

- Requirements would be issued for monitoring and maintaining the integrity of the CAD cell cap. This would include periodic borings to ensure that cap thickness is maintained.

The Navy would administer the land use restrictions for as long as it owns the property. Future cleanup, if undertaken, could reduce the need for, or scope of, the land use restrictions.

Absent further cleanup, in the event of transfer of the property, it would be necessary to include deed or use restrictions. Deed restrictions cannot be placed on the property until transfer of the property. Upon property transfer, notification of the history of the site would be attached to any property transfer and the property transfer would have to meet the requirements of CERCLA Section 120(h).

Specific institutional control requirements are discussed in Section 12 of this ROD.

10.4.9 Maintenance

The shoreline stabilization actions would be maintained as described under Alternative SD2.

Alternative SD7 would also require long-term maintenance of the CAD cells. Because the excavated CAD cells would isolate the contaminated sediments beneath the existing mudline, and are located in an area where sediments are generally depositing over time, the potential for physical damage to the containment system is considered to be very low. However, there is still some potential for damage to the cap over the long term (e.g., damage by large anchors). Any maintenance or repairs would likely consist of placing additional capping material atop the CAD cells. The need for any such maintenance would be determined by the results of the monitoring program. The cost estimate includes nominal costs for physical maintenance of the cap.

10.4.10 Periodic Reviews

Because this alternative may result in some exceedances of state cleanup levels remaining in sediments and institutional controls that require limits on subtidal land uses, a periodic review of the environmental data would be required no less frequently than every 5 years. The environmental data would be used by EPA, Ecology, and the Navy to ensure that the alternative remains protective of human health and the environment.

10.5 COMMON ELEMENTS AND DISTINGUISHING FEATURES OF EACH ALTERNATIVE

10.5.1 Common Elements

Alternatives SD2 and SD7 share several common elements associated with dredging, erosion control, enhanced natural recovery, in situ capping, and monitoring.

Dredging of CERCLA Sediments

Alternatives SD2 and SD7 both include dredging the same amount of CERCLA sediment, and would accomplish the same risk reduction associated with removal of PCBs from the biologically active surface layer of sediments.

Navigational Dredging

For all sediment alternatives, navigational dredging is expected to occur as planned, and hence some sediments containing PCBs would be removed. Therefore, some limited risk reduction would be associated with the removal and disposal of the navigational dredge sediments. Because dredging is an operational requirement of the BNC, no costs are assumed in any alternatives for the removal and disposal of the navigational dredge sediments. The navigational dredging would be considered “incidental cleanup” under WAC 173-204-550.

Habitat Implications of Dredging

Alternatives SD2 and SD7 each would have a short-term impact to habitat associated with dredging. Existing benthic communities in the targeted areas would be destroyed by the dredging operations. Newly exposed sediments would be left to naturally recolonize. No costs are assumed for habitat restoration or mitigation as a result of the dredging operations. Under state law (RCW 75.20, Section 5) mitigation would not be required for the capping and dredging operations.

Under Alternative SD2 or SD7, potential impacts to endangered species would be assessed in a biological assessment, and reasonable and prudent measures would be incorporated into the project.

Erosion Control at Site I

Alternatives SD2 and SD7 each include the same combination of cleanup actions to address the unique conditions associated with the nearshore fill area at Site I. The cleanup actions would include measures to improve slope stability and enhanced riprap protection on the shoreline. Design specifics would be determined in the remedial design.

In Situ Capping Near OU A

Alternatives SD2 and 5D7 each include placement of a thick-layer cap over sediments that exceed the remedial action level in the nearshore OU A area. Design specifics would be determined in the remedial design.

Enhanced Natural Recovery

Alternatives 5D2 and SD7 each include placing a thin layer of clean sediments in the area offshore from OU A and outside the navigational channel. This will provide additional risk reduction by immediately reducing average PCB concentrations in the biologically active surface layer of sediments in the thin- layer cap area. The design specifics of the thin-layer capping would differ somewhat between the two alternatives. Under Alternative SD7, the thickness of the thin-layer cap may be increased in some areas to accomplish the habitat restoration actions.

Natural recovery of sediments throughout Sinclair Inlet is expected to occur under all of the alternatives, as a result of natural sediment transport processes. Over the long term, natural recovery is expected to provide the greatest reduction in the area-weighted average PCB concentrations.

Monitoring of Sediments and Tissue

Monitoring during implementation of the remedial actions would be conducted to assess short-term environmental effects and to confirm compliance with the remedial design. This compliance monitoring would consist of water quality monitoring and bathymetric surveys.

Following cleanup, physical, chemical, and biological monitoring would be performed as defined in a monitoring plan to be developed.

Institutional Controls

Alternatives SD2 and SD7 each include institutional controls to maintain protection of human health and the environment over the long term.

Applicable or Relevant and Appropriate Requirements (ARARs)

Numerous action- specific and location-specific ARARS are associated with the common elements of the cleanup alternatives. No ARAR waivers would be required for either alternative SD2 or SD7. A complete list of ARARs and items "to be considered" (TBC) associated with the selected remedy is found in Section 13 of this ROD.

10.5.2 Distinguishing Features

The primary differences between the alternatives are associated with the disposal method used for the CERCLA sediments and the ability to coordinate the remedy with the navigational dredging project.

Disposal of CERCLA Sediments

Under Alternative SD2, the CERCLA sediments would be transported off site by truck or rail to an upland location and placed in a permitted landfill. Under Alternative SD7, the CERCLA sediments would be contained on- site in excavated CAD cells. Construction of the CAD cells would generate clean sediments that could be used for beneficial purposes elsewhere or disposed of at a DMMP in-water disposal location.

Disposal of Unsuitable Navigational Sediments

Under Alternative SD2, the unsuitable navigational sediments would be handled separately from the CERCLA sediments. Under Alternative SD7, the unsuitable navigational sediments would be placed in the excavated CAD cells with the CERCLA sediments.

Implementation Timeframe

Alternative SD7 could be implemented within one year. Implementation of Alternative SD2 could be delayed for several years because it would not be coordinated with the navigational dredging program, and access to dredge locations would be limited.

Habitat Implications of Sediment Disposal

Under Alternative SD2, there are no habitat modifications or impacts associated with upland landfill disposal. Under Alternative SD7, construction of the CAD cells would temporarily destroy approximately 10 acres of existing benthic communities. Additional short-term impacts to habitat may be associated with temporary stockpiling of sediments that may be required for CAD cell construction. Once the final cap is placed, the CAD area will be returned to its approximate original elevation and the original benthic community could re-establish itself in clean cap sediments.

Habitat Restoration

Under Alternative SD2, habitat restoration is not incorporated into the design of the in situ cap for FSSUs offshore from OU A. Under Alternative SD7, the cap may be modified to include placement of additional, thicker layers of sediments or other imported materials in nearshore portions of the designated capping area. The intent of placing this additional material is to improve habitat quality in this area.

ARARs

Under Alternative SD2, certain action-specific ARARs would be associated with the offsite transport and disposal of the sediments. Under Alternative SD7, certain action-specific and location-specific ARARs would be associated with the in-water disposal actions. No ARAR waivers would be required for either alternative. A complete list of ARARs and TBCs associated with the selected remedy is found in Section 13 of this ROD.

Long-Term Reliability

The long-term reliability of alternatives SD2 and SD7 is considered to be very high. There are some differences in the issues surrounding the long-term reliability of the disposal components, as discussed below:

- **Seismic Stability**. Under Alternative SD2, any seismic stability concerns would be unique to the specific upland landfill disposal location selected. The seismic stability of most landfills is considered high. Under Alternative SD7, the CAD cells would be constructed below grade and returned to original bottom contours, and hence seismic stability is considered high.

- **Contaminant Leaching**. Under Alternative SD2, the contaminated sediments would be placed in a permitted landfill that would include a liner, cap, and leachate collection system. Long-term maintenance of the landfill and monitoring of groundwater would be required and is expected to be provided by the landfill operator. Under Alternative SD7, long-term water quality impacts at the point of disposal were evaluated using the thin- layer column leach test. Associated chemical transport modeling using leach test results indicates that long-term transport of chemicals from an excavated CAD would be minimal and would not result in any exceedances of water quality criteria. Water quality at the CAD surface will be sampled under the monitoring program.

Costs

Table 10-4 summarizes the estimated capital costs, annual operation and maintenance (O&M) costs, and total present worth costs of the alternatives. The alternative cost estimates are projected over a 30-year period of O&M, and assume a discount factor of 7 percent.

The containment cells constructed under Alternative SD7 would be appropriately sized to provide disposal capacity for the unsuitable navigational dredge sediments. The cost estimate for Alternative SD7 has been discounted to include only the portion of the cost associated with the CERCLA sediments.

10.6 EXPECTED OUTCOMES OF EACH ALTERNATIVE

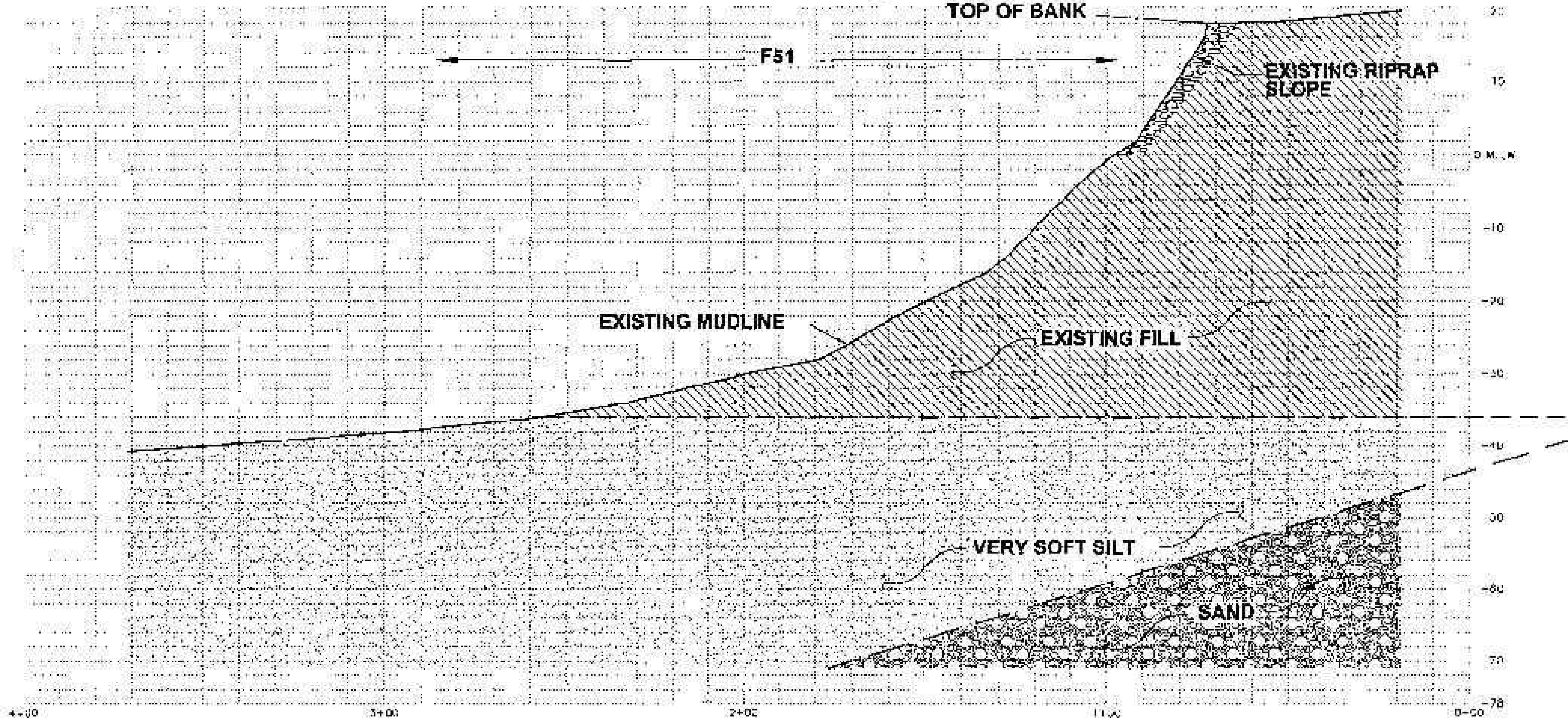
None of the alternatives are expected to significantly modify current land use within Sinclair Inlet. However, under Alternative SD7, restrictions on anchor sizes and future dredging would be required in the area of the CAD cells, to protect the CAD caps. Such restrictions would not affect any current vessel traffic that occurs in this area, but could preclude the anchoring of larger vessels in this area in the future,

Alternatives SD2 and SD7 are expected to reduce the area-weighted average PCB concentrations in Sinclair Inlet by about 10 percent, immediately following remediation. Also, the shoreline stabilization measures under these alternatives are expected to minimize any recontamination caused by eroding fill material. Natural recovery of sediments is expected to continue over the long term, reducing the area-weighted average concentration of PCBs in surface sediment throughout Sinclair Inlet. Current modeling estimates predict that the MCUL of3 mg/kg OC PCB would be achieved within 10 years at marine OU B.

For both alternatives 5D2 and 5D7, it is expected that the reduction in area- weighted average concentrations of PCBs in surface sediments will eventually result in reductions in PCB concentrations in marine tissue. However, it is not possible to make quantitative estimates of the degree of, or timing of, any reduction in PCB concentrations in marine tissue. Until the concentrations of PCBs in marine tissue reach levels consistent with reference area values, it is anticipated that restrictions may be placed on tribal subsistence harvesting of English sole and/or rockfish from Sinclair Inlet. My such restrictions would be administered by the Suquamish Tribe and/or the Washington State Department of Health (WDOH).

Under Alternatives SD2 and SD7, physical, chemical, and biological monitoring would be performed as defined in a monitoring plan to be developed.

Site 1
Cross Section of Existing Conditions



Horizontal Scale: 1" = 40'
Vertical Scale: 1" = 20'

Site 1 Plan

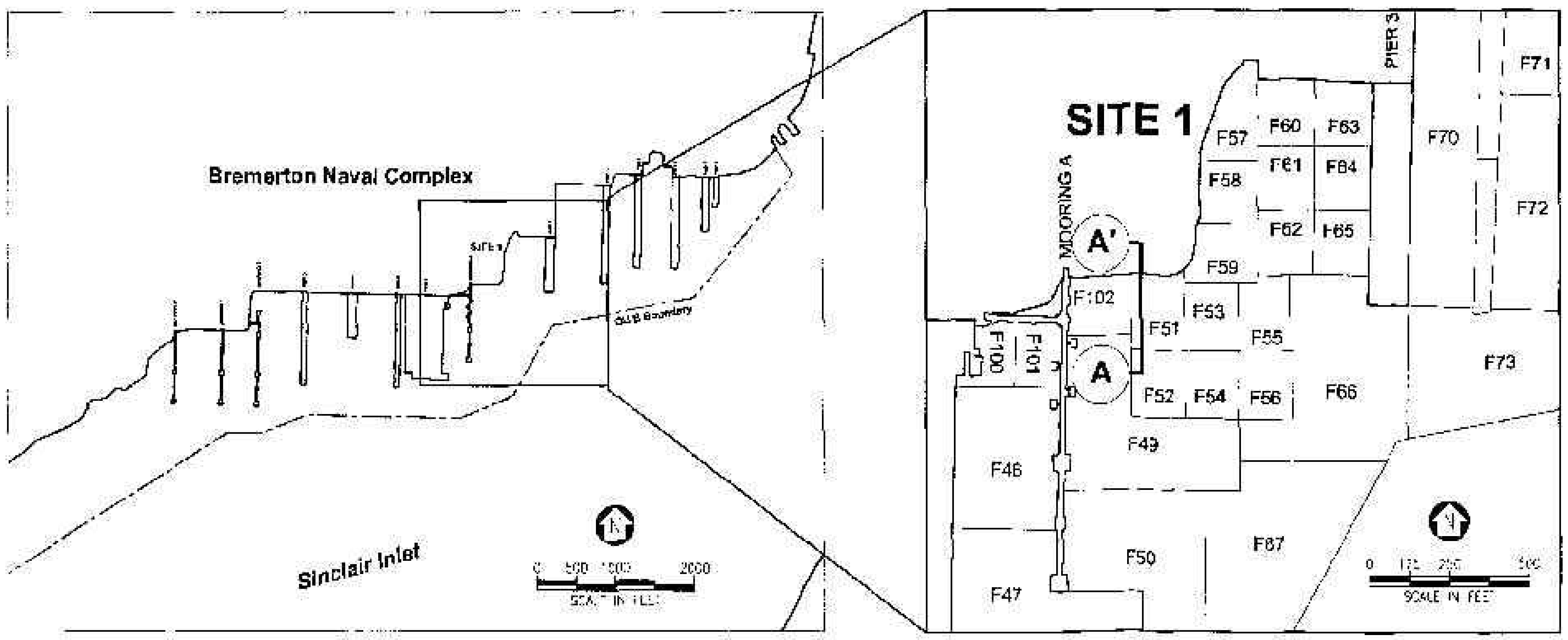


Figure 10-1
Site 1
Shoreline Fill Area

CLEAN
COMPREHENSIVE LONG TERM ENVIRONMENTAL ACTION NAVY

CTO 0131
OU B MARINE
Bremerton, WA
RECORD OF DECISION

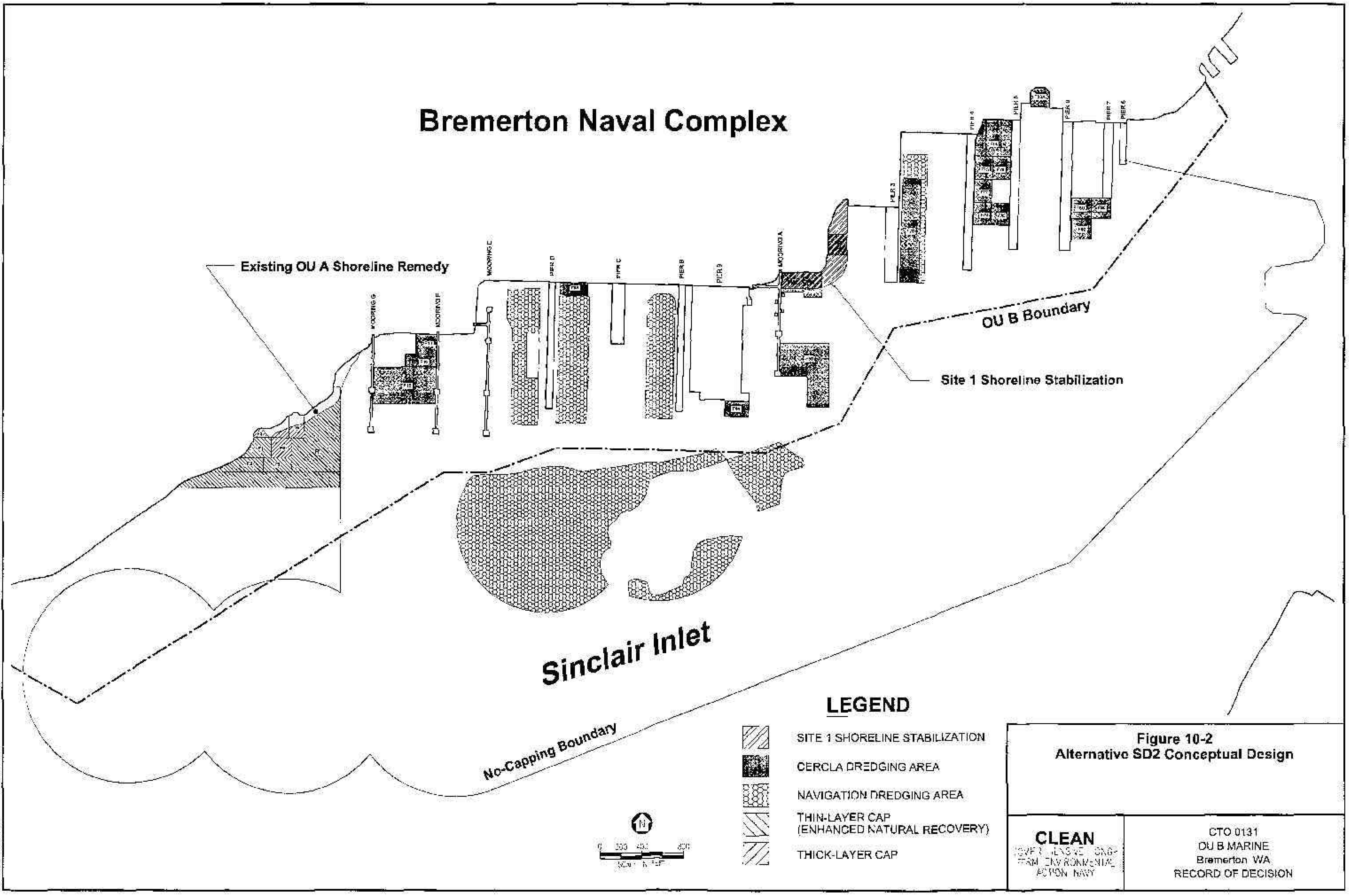
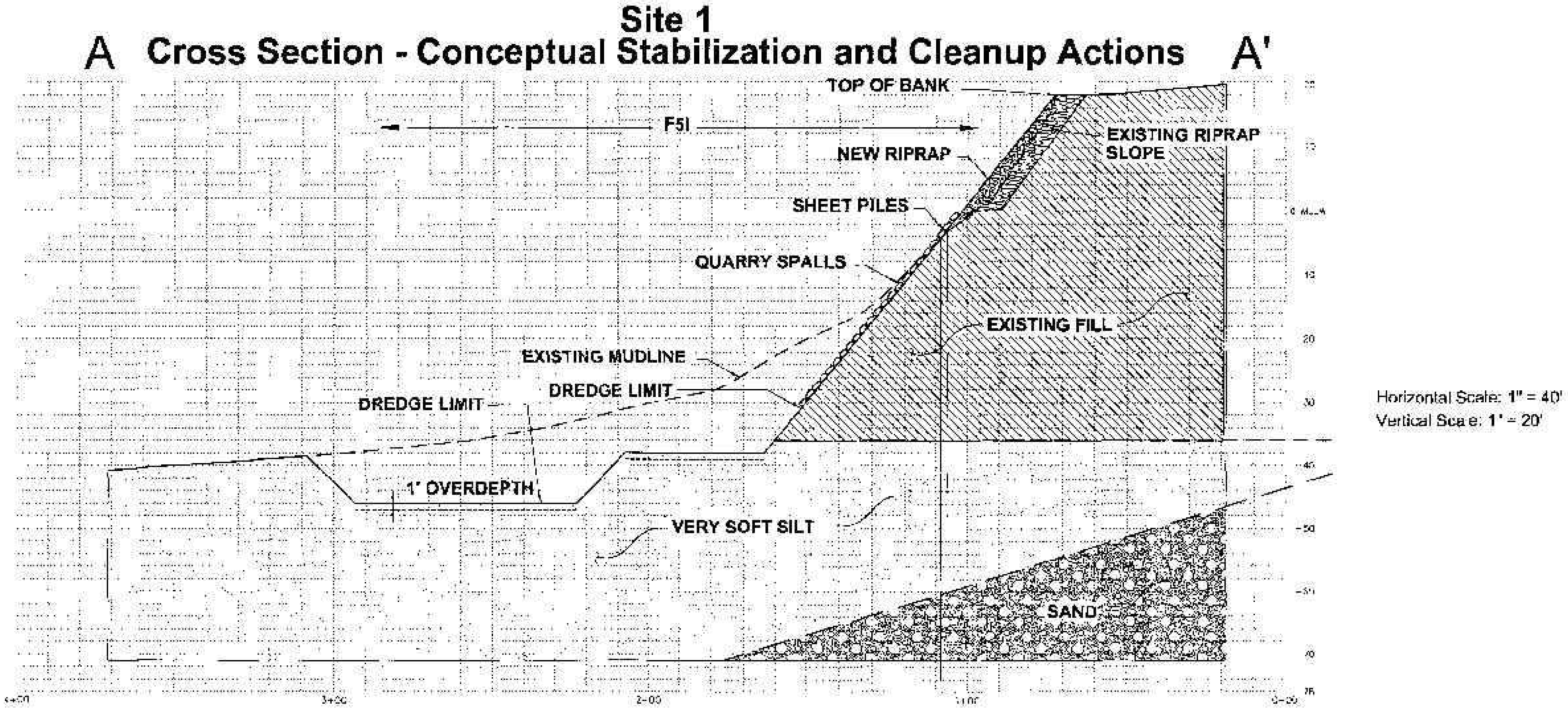


Figure 10-2
Alternative SD2 Conceptual Design



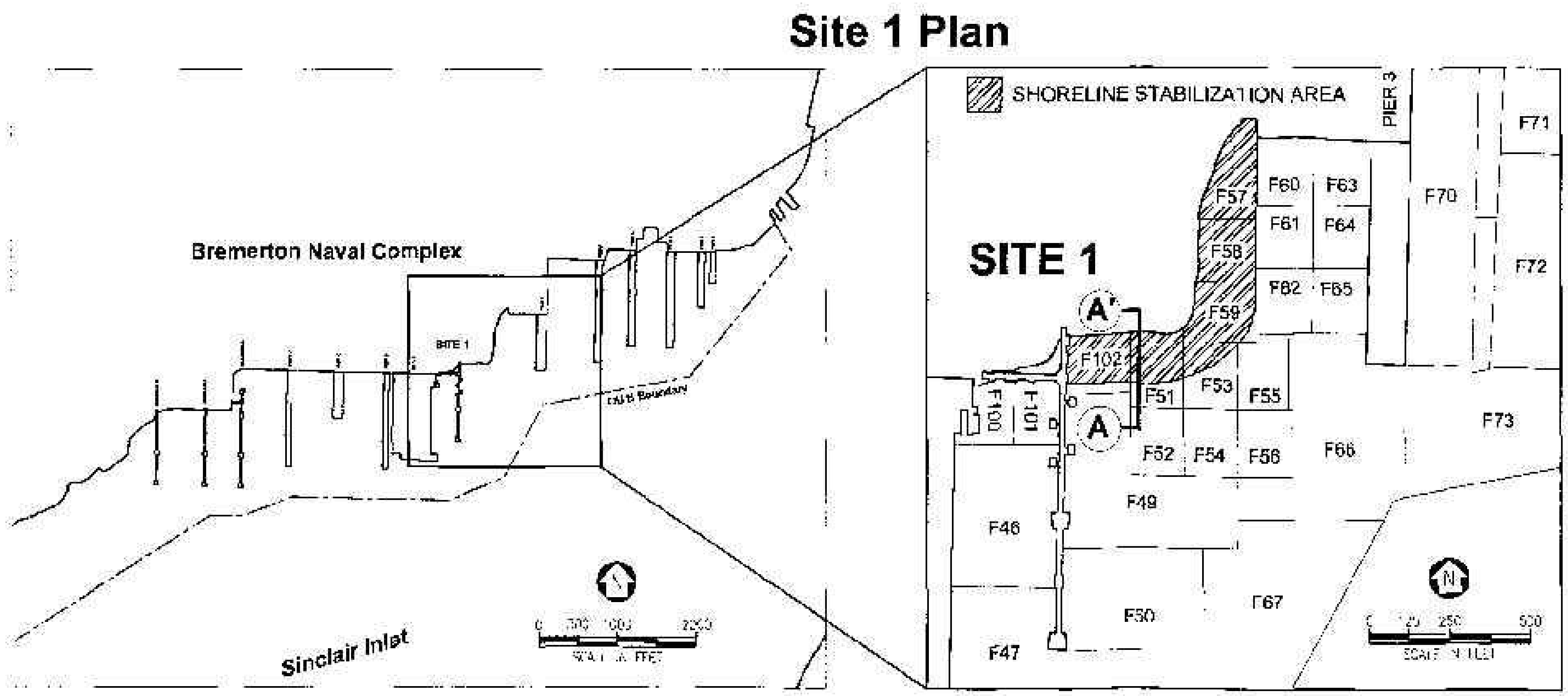


Figure 10-3
Site 1
Conceptual Approach for Shoreline Stabilization

CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

CTO 0131
OU B MARINE
Bremerton, WA
RECORD OF DECISION

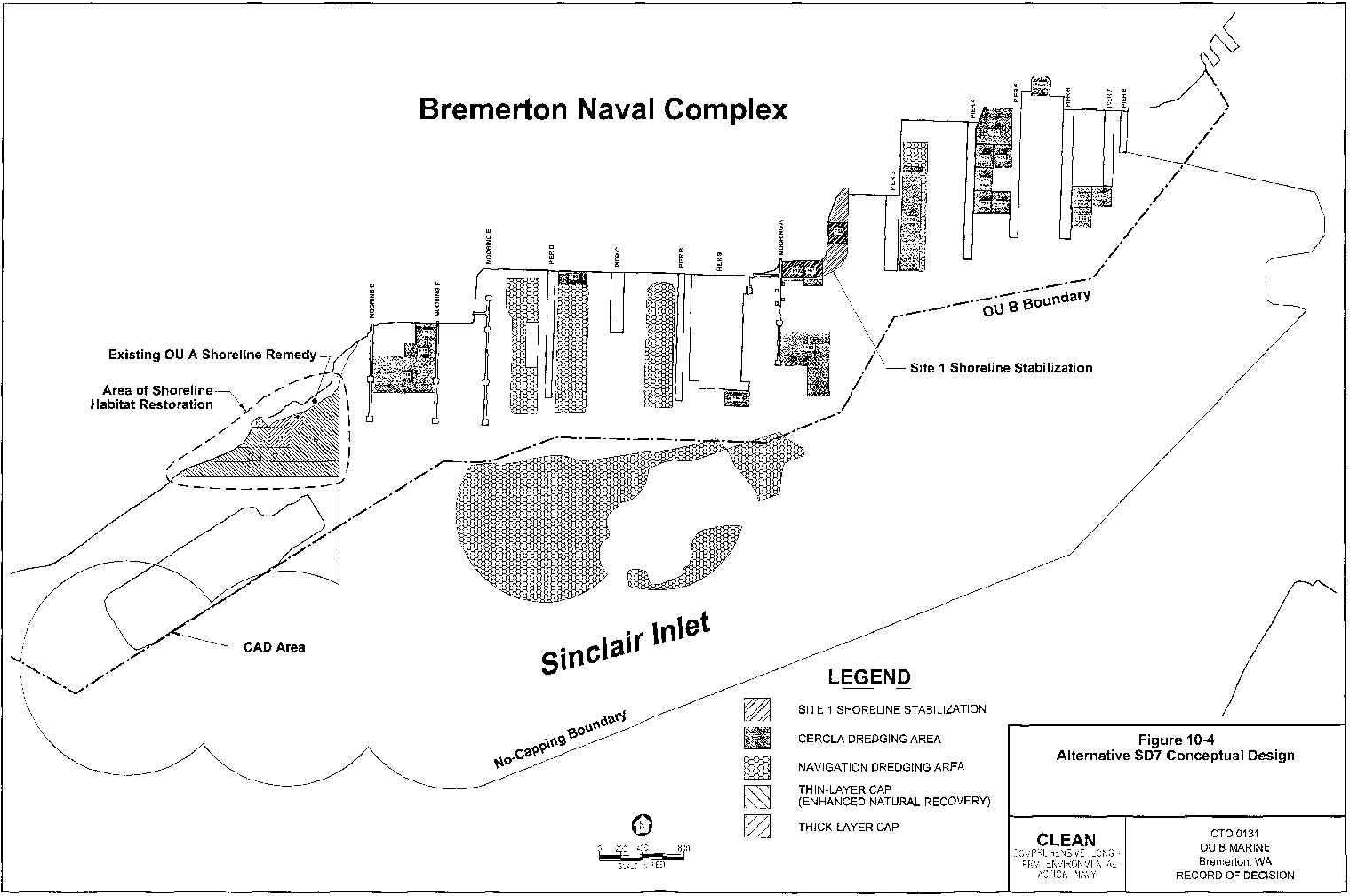


Figure 10-4
Alternative SD7 Conceptual Design

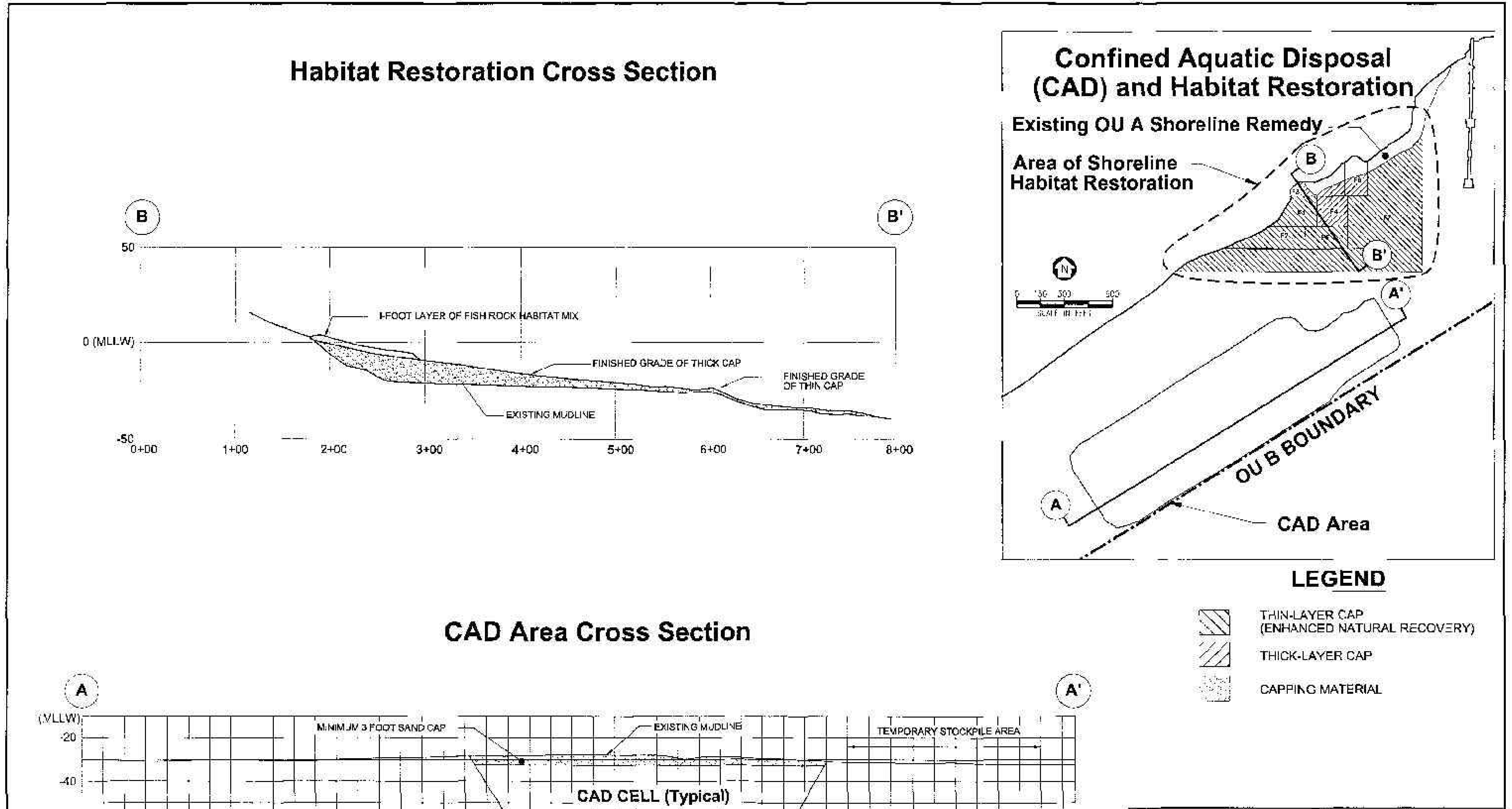


Figure 10-5
Alternative SD7
Confined Aquatic Disposal (CAD) and
Habitat Restoration Cross Section

CLEAN

CTO 0131
OU B MARINE
Bremerton, WA
RECORD OF DECISION

Table 10-1
Marine Sediment Alternatives Considered in the Draft Feasibility Study

Alternative	Description
Alternative SD 1: No Action	• No active cleanup of sediments would occur • Natural processes such as sedimentation are expected to improve sediment quality over several decades • Does not include any monitoring
Alternative 5D2: Dredging with Upland Landfill Disposal	• Sediment exceeding the PCB action level of 12 mg/ kg OC would be dredged • Dredged sediment would be dewatered as needed, and hauled to a permitted landfill for disposal • A thin layer cap of clean sediment would be placed in southwest portion of BNC • Sediment and English sole from Sinclair Inlet would be monitored regularly to assess improvement
Alternative SD3: Dredging with Upland Monofill Placement	• Includes the same dredging, capping, and monitoring as Alternative 2. • Dredged sediment would be used to fill a lined monofill cell constructed in a ravine on ONC land. The cell would include a protective cap and leachate collection and treatment system. • The monofill cell would be maintained and monitored
Alternative SD4: Dredging with Nearshore Confined Aquatic Disposal	• Includes the same dredging, capping, and monitoring as Alternative 2, • Dredged sediment would be placed in a submerged disposal cell along the shoreline. The disposal cell would be built on top of the existing seafloor, making this area more shallow. The disposal cell would have a berm and cap to contain and isolate the dredged sediment. The cap would have a sloped surface at intertidal elevations to promote habitat. • The disposal cell would be maintained and monitored
Alternative SD5A: Dredging with Offshore Confined Aquatic Disposal	• Includes the same dredging, capping, and monitoring as Alternative 2. • One or more disposal pits would be excavated into the seafloor. The pits would be located on State-owned submerged land in the western portion of Sinclair Inlet. Clean sediments from the disposal pit excavation would be disposed of at an open-water disposal location. • Dredged contaminated sediment would be placed in the pits. and the pits would be capped to contain and isolate the dredged sediment. The seafloor would have its original depth once the pits are filled. • The disposal cell would be maintained and monitored
Alternative SD5B: Dredging with Offshore Confined Aquatic Disposal and Habitat Restoration	• Includes the same dredging, capping, and monitoring as Alternative 2. • Dredged sediment would be placed in seafloor pits as described in Alternative 5A • Clean sediments from the disposal pit excavation would be placed in a structure constructed on the north shoreline of Sinclair Inlet. The structure would serve to convert the existing steep riprap shoreline profile to a gently sloping intertidal area. This would be designed to restore nearshore marine habitat. • The disposal cell would be maintained and monitored
Alternative SD6: Dredging with Nearshore Contained Disposal	• Includes the same dredging, capping, and monitoring as Alternative 2. • Similar to Alternative 4, the dredged sediment would be placed in a disposal cell along the shoreline, Under this alternative, the cell would be built higher to match the land surface and create new land. The disposal cell would have a berm and cap to contain and isolate the dredged sediment. • The disposal cell would be maintained and monitored

Notes:
BNC - Bremerton Naval Complex
FS - feasibility study
mg/kg - miiligramper kilogram
OC - organic carbon
PCB - polychlorinated biphenyl

Table 10-2
Stakeholder Workshop Criteria
for Sediment Remediation Alternatives

Workshop Criterion
Protection of Habitat and Ecosystems
Contribution toward protection of the estuarine environment
[Avoidance of] Impacts on shellfish health
Protection of birds and other protected species
Protection and/or enhancement of upper intertidal surf smelt spawning areas
Biomagnification effects on the health of biota
Impacts on nourishment to beaches
Avoidance of exacerbation of anoxic conditions
Avoidance of adverse effects on nearshore migration patterns
Avoidance of impacts during the migration seasons
Ability to combine cleanup with habitat restoration
Net gain of nearshore habitat
Avoidance of the creation of fills and hardening of the shoreline
Ability to be self-mitigating
Contribution to a baywide solution
Protection of Natural and Cultural Resources
Contribution toward protection of both shellfish and finfish
Protection of the chum stock in Blackjack Creek
Ability to maintain and enhance fish productivity
Protection of treaty reserve resources
Preservation and enhancement of the ability of the tribe to exercise treaty fishing rights
Contribution toward reducing contaminants causing fisheries closures
Contribution toward protecting fisheries to allow safe human consumption
Protection of cultural resources including religious. ceremonial, and subsistence resources
Protection of Land Uses
Contribution toward land-use practices to protect water quality
Provision of public access to beaches
Avoidance of impacts on vessel operations
Protection of access to commercial fisheries and fishing grounds

Table 10-3
Summary of Feasibility of Marine Sediment Alternatives

Alternative	Major Concerns Regarding Feasibility	Included/Excluded From Further Consideration in this ROD	Primary Modifications to Alternative Components Described in FS
Alternative SD1: No Action	• This alternative does not meet the threshold criteria (protection of human health and the environment and compliance with ARABs).	• Included for further consideration, as required by NCP	• None
Alternative SD2: Dredging with Upland Landfill Disposal	• Alternative is considered feasible, although there are implementability concerns associated with sediment dewatering and logistics • Would not allow for concurrent management of navigational dredged material	• Included for further consideration	• Revised estimate of dredge volume • Inclusion of Site 1 shoreline protection actions
Alternative SD3: Dredging with Upland Monofill Placement	• Serious concerns regarding long-term effectiveness (seismic risks; need for continued leachate collection and treatment) • Serious concerns regarding implementability (volume restrictions) • Would not allow for concurrent management of navigational dredged material	• Excluded from further consideration, based on poor long-term effectiveness and implementability	• This alternative is no longer considered feasible
Alternative SD4: Dredging with Nearshore Confined Aquatic Disposal	• Serious concerns with the time and cost to construct (engineered berm structural features required to overcome seismic risks associated with the nearshore CAD) • Construction of a sloping cap at intertidal elevations is not feasible; a level cap would be required with little habitat value • Serious concerns regarding implementability (obtaining approvals from other agencies) • Would not allow for concurrent management of navigational dredged material	• Excluded from further consideration, based on poor implementability	• This alternative is no longer considered feasible
Alternative SD5A: Dredging with Offshore Confined Aquatic Disposal	• Severe implementability concerns associated with obtaining approvals from other agencies for disposal on State-owned land. • Allows concurrent management of navigational dredged material	• Excluded from further consideration based on poor implementability	• This alternative is no longer considered feasible
Alternative SD5B: Dredging with Offshore Confined Aquatic Disposal and Habitat Restoration	• Severe implementability concerns associated with the construction of habitat restoration and obtaining approvals from other agencies for disposal on State-owned land. • Allows concurrent management of navigational dredged material	• Excluded from further consideration based on poor implementability	• This alternative is no longer considered feasible

Table 10-3 (Continued)
Summary of Feasibility of Marine Sediment Alternatives

Alternative	Major Concerns Regarding Feasibility	Included/Excluded From Further Consideration in this ROD	Primary Modifications to Alternative Components Described in FS
Alternative SD6: Dredging with Nearshore Contained Disposal	• Serious concerns with the time and cost to construct (engineered berm structural features required to overcome seismic risks associated with the nearshore CDF) • Serious concerns regarding implementability (obtaining approvals from other agencies) • Would not allow for concurrent management of navigational dredged material	• Excluded from further consideration based on poor implementability	• This alternative is no longer considered feasible
Alternative SD7: Dredging with Excavated Confined Aquatic Disposal	• Alternative is considered feasible. • Allows for concurrent management of navigational dredged material • Construction of an excavated cell on Navy-owned land overcomes concerns associated with Alternative SD5A and SD5B (Agency approvals)	• Included for further consideration	• This alternative was not described in the Draft FS, but was presented in the proposed plan. It is a variation of Alternative SDSA, with the excavated CAD cell constructed on Navy- owned property instead of State- owned property.

Notes:
ARAR - applicable or relevant and appropriate requirement
CAD - confined aquatic disposal
CDF - confined disposal facility
FS - feasibility study
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
ROD - record of decision

Table 10-4
Summary of Alternative Costs

Alternative	Capital Cast	Annual O&M	Total Present Worth
SD1: No Action	$0	$0	$0
SD2: Dredging with Upland Landfill Disposal	$33,800,000	$124,000	$35,300,000
SD7: Dredging with Excavated Confined Aquatic Disposal	$11,600,000	$193,000	$14,000,000

Note:
O&M - operation and maintenance

11.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The EPA has developed nine criteria for the detailed evaluation of remedial alternatives. These criteria address CERCLA requirements as well as related technical and policy considerations important in selecting remedial procedures. In addition to serving as the basis for detailed analyses conducted during the FS process, the nine criteria provide the framework by which a remedial action alternative is selected.

Each of the evaluation criteria is described in detail in the EPA guidance. The first two serve as threshold criteria that must be met by an alternative prior to selection. An overview of each criterion is included in the following discussions of the comparative analysis. Table 11-1 summarizes the results of the comparative analysis

11.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, or institutional controls.

The primary human health risks associated with sediments are to subsistence consumers of seafood (English sole) that contains PCBs. The calculated excess lifetime carcinogenic risk from this pathway is 4 x 1O~4. The underlying assumption for sediment remedial alternative development is that reducing PCB concentrations in sediments in the biologically active surface layer will result in a long- term reduction in PCB concentrations in the tissues of English sole.

Alternative SD1 (the no-action alternative) would include no actions to remove or consolidate PCB-contaminated sediments, and would not prevent exposures of concern. The existing human health carcinogenic risk of4 x 1O~ would remain for subsistence finfish harvesters. No remedial actions such as dredging would occur that would disrupt existing habitat. No actions would be taken to reduce the potential environmental risks posed by COCs in sediment. Natural recovery mechanisms would reduce sediment PCB concentrations and human health risks over time, although bioaccumulation would persist during this time. Because Alternative SD1 would not reduce the estimated human health risk and does not meet this threshold criterion, it is eliminated from further consideration and is not included in the following sections that discuss the remaining evaluation criteria.

Alternative SD2 (dredging with upland landfill disposal) would reduce human health and environmental risk by removing the most highly contaminated sediments from the marine environment and disposing of the sediments in a permitted landfill. Alternative SD7 (dredging with excavated CAD) would provide the same reduction in human health and environmental risk by consolidating the most highly contaminated sediments into an engineered containment cell within the marine environment. The primary difference between these alternatives is the disposal site selection.

Both alternatives SD2 and SD 7 would provide additional risk reduction through erosion control measures at Site 1, and a combination of capping and enhanced natural recovery (thin-layer capping) in the area offshore from OU A. Continued natural recovery of sediments throughout Sinclair Inlet would occur over time. Alternatives SD2 and SD7 would each control residual risks by conducting environmental monitoring to document and verify effectiveness, implementing institutional controls to maintain the remedy, and by conducting periodic reviews of site information. Seafood harvesting may be restricted by others, if needed, to control residual human health risks until COC concentrations in marine tissue decrease to acceptable levels.

Some ecological risks may currently exist due to the presence of several inorganic chemicals that exceed the SQS; however, the ecological risk assessment could not quantify these potential risks or identify any suitable basis for remedial decision making. Thus, none of the alternatives include specific actions to reduce potential ecological risks that may exist. However, the sediment remedial actions that are being considered to address the human health risks would result in the coincidental removal of some sediments that may be posing ecological risks.

None of the various alternatives would have significant long- term impacts to ecological receptors in terms of habitat disruption, creation, or destruction. The dredging actions under alternatives SD2 and SD7 would temporarily destroy existing benthic communities, although recolonization would occur over a period of months or years. These short-term effects would be greater under Alternative SD7 because of the CAD cell construction. Alternative SD2 would not result in long-term changes in the overall quantity or quality of existing marine habitat types in Sinclair Inlet. Alternative SD7 would include some habitat restoration in the OU A shoreline area.

In summary, sediment alternatives SD2 and SD7 each provide adequate and comparable overall protection of human health and the environment, while Alternative SD 1 does not protect human health or the environment.

11.2 COMPLIANCE WITH ARARS

Section 121(d) of CERCLA and NCP 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as 'ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether the remedy will meet all of the applicable or relevant and appropriate requirements of other State and Federal environmental statutes or provides a basis for invoking a waiver.

Alternatives SD2 and SD7 would each comply with chemical-specific ARARs, including the Washington Sediment Management Standards.

Alternatives SD2 and SD7 have common ARARs associated with the dredging, shoreline stabilization, and thin-layer capping actions. Critical location-and action-specific ARARs for these alternatives include CWA Section 404 requirements for in-water dredge material disposal, Rivers and Harbors Act requirements for modifications to navigable waters, and the Endangered Species Act. Under the Endangered Species Act, a biological assessment and consultation with the National Marine Fisheries Service (NMFS) is required to evaluate effects on the threatened Chinook salmon and other sensitive species. If the NMFS issues a biological opinion of jeopardy to a threatened or endangered species, then the Navy would be required to avoid the action or take appropriate mitigation measures. Both alternatives SD2 and SD7 would also comply with the Dredged Material Management Program (DMMP) guidance criteria for evaluating sediments for suitability for unconfined open-water disposal in Puget Sound, which is a TBC guidance.

Alternative SD7 would involve additional in-water disposal of dredged material, including on-site disposal of the dredged CERCLA and navigational sediments, and off-site disposal of clean sediments from the CAD cell excavation. The excavated CAD under Alternative SD7 would be constructed entirely on Navy-owned property and within the site as "on site" is defined in the NCP, and thus would have to demonstrate compliance with the substantive requirements of the above mentioned ARARs. A portion of the clean sediments from the CAD cell excavation would be disposed of off site at an approved open-water disposal facility.

In summary, both Alternatives SD2 and SD7 could attain their respective Federal and State ARARs, and permits could be obtained where required.

11.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

Alternatives SD2 and SD7 would both have a high degree of long-term effectiveness and permanence. The upland disposal action under Alternative SD2 and the confined aquatic disposal actions under Alternative SD7 would permanently eliminate exposures of aquatic receptors to the sediments containing the highest levels of PCBs. Combined with the shoreline stabilization, capping, and enhanced natural recovery actions, both alternatives are expected to effectively and permanently reduce area- weighted average PCB concentrations in surface sediments within Sinclair Inlet.

The primary residual risk remaining following implementation of Alternatives SD2 or SD7 is the excess carcinogenic risk associated with PCB concentrations in marine tissue. It is expected that both alternatives will result in a long-term reduction in PCB concentrations in the tissues of English sole, with a commensurate reduction in human health risk. The rate at which this residual risk decreases is unknown, but is expected to be the same for both alternatives.

Additional residual risks are associated with the disposal technology used for the dredged sediments, primarily related to seismic stability and contaminant mobility. Under Alternative SD2, the upland disposal site (an off-site landfill) would have little or no risk of failure from seismic events, and no on-site residual risk would remain from leachate. However, land disposal involves potential off-site residual risk from leachate. Changes in physiochemical conditions caused by exposing the marine sediments to freshwater infiltration in an upland containment cell may increase chemical mobility from sediments to leachate. Under Alternative SD7, the excavated CAD would have little risk of disturbance by seismic events. Chemical testing and modeling indicate that there would be no unacceptable residual risk from leachate.

The residual risks associated with both Alternatives SD2 and SD7 could adequately and reliably be controlled. Alternatives SD2 and SD7 would each control residual risks by conducting environmental monitoring to document and verify effectiveness, implementing institutional controls to maintain the remedy, and by conducting periodic reviews of site information. Seafood harvesting may be restricted by others, if needed, to control residual human health risks until COC concentrations in marine tissue decrease to acceptable levels. Reviews at least every 5 years, as required, would be necessary to evaluate the effectiveness of these alternatives because PCBs would remain in sediments at concentrations above health-based levels.

Under Alternative 5D2, the long-term residual risks from leachate would be controlled, assuming the leachate collection and treatment systems at the landfill function properly. Under Alternative SD7, land use restrictions would prevent disturbances to the CAD cells, and monitoring would confirm the integrity of the CAD cells and that leachate concentrations are acceptable. Maintenance requirements for the CAD cap structure are expected to be minimal, potentially consisting of depositing additional cap material should damage occur.

In summary, Alternatives SD2 and 5D7 both provide a high degree of long- term effectiveness and permanence.

11.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternatives 5D2 and SD7 involve placement of the sediments into engineered containment disposal facilities, and do not include any active treatment measures to reduce the toxicity, mobility, or volume of contaminants in the sediments.

For the upland disposal alternative (SD2), the mobility of some chemicals in the untreated sediments may actually increase as a result of changes in physiochemical conditions. It is expected that leachate under this alternative would contain higher concentrations of some chemicals when compared to Alternative SD7. Alternative SD2 would include collection and treatment of leachate at the upland disposal facility. For Alternative SD7, leachate volumes and concentrations are expected to be lower, and some degree of passive leachate treatment due to natural geochemical processes could be expected within the CAD cell cap.

Although neither Alternative SD2 or SD7 include active treatment, actions considered under both of these alternatives satisfy EPA's expectation that treatment should be used to address the principle threats posed by a site wherever practicable. The contaminated sediments in the marine environment at OU B that are addressed by this ROD are not considered to be principle threat wastes. They are not highly toxic or highly mobile, and they can reliably be contained. Further, treatment was not found to be practicable for the sediments. Actions considered under Alternatives SD2 and SD7 are consistent with EPA's expectation for use of engineering controls, such as containment, for waste that poses a relatively low, long-term threat or where treatment is impracticable (40 CFR 300.430(a)(1)(iii)(B)).

Alternative SD7 involves on-site containment of contaminated sediments, which is consistent with Ecology's and EPA's biases against off-site land disposal of untreated waste. Upland landfill disposal under Alternative SD2 is counter to EPA's bias against off-site land disposal of untreated waste.

11.5 SHORT-TERM EFFECTIVENESS

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

During implementation, Alternatives SD2 and SD7 would each pose some short-term risks to workers from remediation construction and to the community from construction traffic. These risks would be limited by engineering and health and safety controls. In general, risks to workers and community are expected to increase with respect to the extent and difficulty of materials handling and extent of off-site transport of contaminated sediments or import materials. Therefore, Alternative SD2 is expected to pose greater short-term risks to workers and the community due to construction safety and traffic factors. Also, the materials handling associated with Alternative SD2 would have a greater potential for uncontrolled accidental releases to the environments.

Unavoidable short-term ecological impacts would occur under Alternatives SD2 and 5D7 from in-water construction (dredging, shoreline stabilization, and placement of material for capping and enhanced natural recovery). These would be greater under Alternative SD7 as a result of construction of the containment cell. These impacts include temporary disruption of habitat and destruction of existing benthic organisms in the marine environment. It is expected that the benthic organisms would repopulate the cleaner sediments and establish a healthier community. Potential short- term risks to organisms within the water column (including salmon) would be controlled through operational controls to limit turbidity during construction, and observation of “fish windows” during which spawning or migration occur and in-water work is prohibited.

The alternatives differ significantly with respect to remediation timeframe. Because it is unlikely that Alternative SD2 could be coordinated with the planned navigational dredging project, Navy logistical constraints may result in a delay of up to several years before remedial construction could begin. Alternative SD7 could be coordinated with the planned navigational dredging project, and could be implemented within months.

Following remediation, the time required to achieve the minimum sediment PCB cleanup level of 3 mg/kg OC throughout Sinclair Inlet is anticipated to be less than 10 years. The time required to achieve significant reduction in PCB concentrations in fish tissue (and hence actual human health risk reduction) cannot be accurately predicted with the present state of the art. Protection of human health could be achieved immediately for the affected population (subsistence seafood harvesters) through harvest restrictions. Some harvest restrictions issued by the Suquamish Tribe and WDOH are currently in place.

In summary, Alternative SD7 has greater short-term effectiveness than Alternative SD2. Alternative SD7 can be implemented faster than Alternative SD2 and poses less short-term risks to workers and the community.

11.6 IMPLEMENTABILITY

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Both Alternatives SD2 and SD7 are technically feasible to construct and operate using existing technology and readily available equipment. The in- water construction activities under each of these alternatives would require careful planning and coordination to avoid disrupting Navy and public navigation requirements, and observance of fish migration windows that limit the construction season.

There are some implementability concerns unique to Alternative 5D2 that are expected to delay implementation. Because it is unlikely that Alternative SD2 could be coordinated with the planned navigational dredging project, logistical constraints may result in a delay of up to several years before remedial construction could begin. Additionally, the relatively limited available space for sediment dewatering, rehandling, and loading for transport could result in a constraint on the throughput and rate at which dredging could occur, and may result in the need to extend the project over two construction seasons. Constraints associated with off-site transport (such as traffic impacts of trucks or container rehandling for barge/rail transport) would also complicate logistics for Alternative SD2.

No component of Alternative SD2 or SD7 would preclude or hinder additional remedial action, if it were needed in the future. Both alternatives could effectively be monitored, and the results of the monitoring and periodic inspections would give notice if maintenance or additional action is needed. Services and equipment are readily available for both alternatives, and no special technologies are required for their implementation.

Both Alternatives SD2 and SD7 have some administrative feasibility concerns. Implementation of either alternative would require a biological assessment to demonstrate compliance with Endangered Species Act requirements, and consultation with natural resource agencies to obtain approval (or determine the need for mitigation or avoidance). Obtaining these agency approvals in a timely manner is a concern (although this concern may not apply to Alternative SD2 if the project schedule was already delayed due to logistical concerns).

In summary, Alternative SD7 is considered more readily implemented than Alternative SD2, primarily in regard to the ability to construct the remedy in a timely manner.

11.7 COST

Cost estimates were prepared using costing techniques that typically achieve an accuracy of +50 percent to–30 percent for a specified scope of actions. Alternatives SD2 and SD7 would require maintenance and monitoring for at least 30 years. The cost estimates were based on 30 years of operation at an annual discount rate of7 percent. The estimated costs of the alternatives are summarized in Table 11-1.

11.8 STATE ACCEPTANCE

The Washington State Department of Ecology, as the state agency designated as lead agency for state implementation of CERCLA, has expressed its support of Alternative SD7. Ecology does not believe that Alternative SD 1 provides adequate protection of human health or the environment.

11.9 COMMUNITY ACCEPTANCE

The Restoration Advisory Board has been involved in the review and comment process of all project documents leading to this ROD. On March 22, 2000, the Navy held an open house and public meeting to discuss the proposed plan for final action for marine OU B. The public comment period extended from March 13, 2000, to April 17, 2000. Public comments received at the public meeting and during the public comment period are summarized and addressed in the Responsiveness Summary of this ROD.

Table 11-1
Comparative Analysis of Alternatives

Criteria	Alternative SD1: No Action	Alternative SD2: Dredging with Upland Landfill Disposal	Alternative SD7: Dredging with Excavated CAD
OVERALL PROTECTIVENESS			
Human Health Protection	Existing cancer risk from subsistence ingestion of fish from Sinclair Inlet exceeds IE-04. No specific actions would reduce or control this risk, Natural sedimentation/ burial processes would provide some long-term reduction in risk.	Dredging and upland disposal, along with capping, enhanced natural recovery, and shoreline stabilization actions are expected to result in decreased marine tissue concentrations and decreased human health risks over time. Natural recovery would further reduce residual risk. Harvest limitations may be used to control residual risk, until marine tissue concentrations decrease.	Same overall level of protection as Alternative SD2. Dredging and containing contaminated sediments in an in-water cell, along with capping, enhanced natural recovery, and shoreline stabilization actions are expected to result in decreased marine tissue concentrations and decreased human health risks over time. Natural recovery would further reduce residual risk. Harvest limitations may be used to control residual risk, until marine tissue concentrations decrease.
Environmental Protection	Would allow continued exposure of environmental receptors to sediments containing the highest levels of PCBs.	Sediment cleanup actions would reduce environmental risks by reducing exposure of environmental receptors to sediments containing PCBs and other COCs present above the SQS. No long-term habitat modifications.	Same overall level of protection as Alternative SD2. Sediment cleanup actions would reduce environmental risks by reducing exposure of environmental receptors to sediments containing PCBs and other COCs present above the SQS. Some habitat modifications along OU A shoreline designed to improve shoreline ecology.

Table 11-1 (Continued)
Comparative Analysis of Alternatives

Criteria	Alternative SD1: No Action	Alternative SD2: Dredging with Upland Landfill Disposal	Alternative SD7: Dredging with Excavated CAD
COMPLIANCE WITH ARARS			
Chemical-Specific ARARS	Would not meet state SMS requirements.	Would comply with all chemical-specific ARARs. SMS MCUL would be met within 10 years.	Would comply with all chemical-specific ARARs. SMS MCUL would be met within 10 years.
Location-Specific ARARs	No location-specific ARARs	Would comply with all location-specific ARARs. Compliance with Endangered Species Act requires consultation with natural resource agencies to determine the need for reasonable and prudent measures.	Would comply with all location-specific ARARs. Compliance with Endangered Species Act requires consultation with natural resource agencies to determine the need for reasonable and prudent measures.
Action-Specific ARARs	No action-specific ARARS	Would comply with all action-specific ARARs.	Would comply with all action-specific ARARs. Off-site disposal of clean sediments may require permits for CWA Section 404 and Rivers and Harbors Act Section 10.
LONG TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk	Current risk to subsistence-level harvesters would remain above 1E-04. Some long-term risk reduction would occur through natural processes. Significant risk would remain for more than 10 years.	Sediment cleanup actions combined with natural recovery are expected to result in a greater decrease in human health risks over time, compared with Alternative SD1. Would permanently remove sediments containing the highest concentrations of PCBs from the marine environment. Low long-term seismic risk. No on-site residual risk from leachate. Land disposal involves potential offsite residual risk from leachate.	Sediment cleanup actions combined with natural recovery are expected to result in an equivalent decrease in human health risks over time, compared with Alternative SD2. Would permanently isolate contaminated sediments containing the highest concentrations of PCBs within a containment cell. Low long-term seismic risk. Chemical testing and modeling indicate that there would be no unacceptable residual risk from leachate.

Table 11-1 (Continued)
Comparative Analysis of Alternatives

Criteria	Alternative SD1: No Action	Alternative SD2: Dredging with Upland Landfill Disposal	Alternative SD7: Dredging with Excavated CAD
Adequacy and Reliability of Controls	Five-year reviews required	Five-year reviews required If needed, harvest restrictions could adequately control residual risks from seafood. Residual risk from leachate would be managed through capping, collection, and treatment by landfill operator. Landfill operator already has provisions for monitoring and maintenance.	Five-year reviews required If needed, harvest restrictions could adequately control residual risks from seafood. Land-use restrictions would prevent damage to CAD cell cap. Monitoring of CAD would confirm protectiveness. Maintenance could readily be provided as needed.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT	Not Applicable.	Treatment of the sediments is not a principal element of this alternative. Satisfies statutory preference for treatment to address principle threats. No principle threats have been identified in the marine environment.	Treatment of the sediments is not a principal element of this alternative. Satisfies statutory preference for treatment to address principle threats. No principle threats have been identified in the marine environment.

Table 11-1 (Continued)
Comparative Analysis of Alternatives

Criteria	Alternative SD1: No Action	Alternative SD2: Dredging with Upland Landfill Disposal	Alternative SD7: Dredging with Excavated CAD
SHORT-TERM EFFECTIVENESS			
Community Protection	Continued risk to community through no action. No additional short-term risks to community as a result of remediation.	Short-term risks to community from off-site transport of waste. Risks would be limited by standard transportation safety measures.	Lower short-term risks to community compared to Alternative SD2, since sediments are disposed on-site.
Worker Protection	No additional short-term risks to workers as a result of remediation	Short-term risks to workers from remediation actions would be limited by standard health and safety measures.	Short-term risks to workers from remediation actions would be limited by standard health and safety measures.
Environmental Impacts	No additional short-term risks to environment as a result of remediation	Minor short-term ecological impacts are expected from dredging, capping, enhanced natural recovery actions.	Minor short-term ecological impacts are expected from dredging, cell construction, capping enhanced natural recovery actions.
Time Until Action is Complete	Not applicable.	Several years may be required to implement the cleanup actions. Time to achieve reduction in marine tissue PCB concentrations is unknown. Protection of human health could be achieved immediately through use of any necessary harvest restrictions.	Construction of cleanup actions could be complete within months. Time to achieve reduction in marine tissue PCB concentrations is unknown. Protection of human health could be achieved immediately through use of any necessary harvest restrictions.

Table 11-1 (Continued)
Comparative Analysis of Alternatives

Criteria	Alternative SD1: No Action	Alternative SD2: Dredging with Upland Landfill Disposal	Alternative SD7: Dredging with Excavated CAD
IMPLEMENTABILITY			
Ability to Construct and Operate	Not applicable.	Logistics may delay implementation for several years. Additional concerns associated with limited space for rehandling and dewatering. Specific dewatering requirements may complicate logistics or increase costs.	Could readily be constructed.
Ease of Doing More Action if Needed	Additional remedial action could be undertaken if needed in the future.	No component of this alternative precludes or hinders additional remedial action, if needed in the future.	No component of this alternative precludes or hinders additional remedial action, if needed in the future.
Ability to Monitor Effectiveness	Not applicable.	Could be effectively monitored. Monitoring and inspections would give notice if maintenance or additional action is needed.	Could be effectively monitored. Monitoring and inspections would give notice if maintenance or additional action is needed.
Ability to Obtain Approvals and Coordinate With Other Agencies	Not applicable.	Potential difficulties in obtaining timely agency approvals. Requires completion of a biological assessment and consultation with natural resource agencies.	Potential difficulties in obtaining timely agency approvals. Requires completion of a biological assessment and consultation with natural resource agencies.
Availability of Equipment, Specialists, and Materials	Not applicable.	Services and equipment are readily available.	Services and equipment are readily available.
Availability of Technologies	Not applicable.	No special technologies required.	No special technologies required.

Table 11-1 (Continued)
Comparative Analysis of Alternatives

Criteria	Alternative SD1: No Action	Alternative SD2: Dredging with Upland Landfill Disposal	Alternative SD7: Dredging with Excavated CAD
COSTS: **Capital** **Operation and Maintenance a** **Total Present Worth b**	 $0 $0 $0	 $33,800,00 $124,000 $35,300,000	 $11,600,000 $193,000 $14,000,000
STATE AND TRIBAL ACCEPTANCE	Not acceptable — Not protective of human health and the environment. Does not satisfy ARARs	Acceptable	Acceptable to State. Conditionally acceptable to Tribe.
COMMUNITY ACCEPTANCE	Not acceptable to community Not acceptable to Suquamish Tribe	Mixed; some favor upland disposal, others favor in-water disposal.	Mixed; some favor upland disposal, others favor in-water disposal.

a Operation and maintenance costs are presented as an avenge annual cost.
b Total present worth cost equals the total equivalent cost of the alternative over 30 years in current dollars, assuming a 7 percent discount factor.

Notes:
ARARs - applicable or relevant and appropriate requirements
CAD - confined aquatic disposal
COC - chemical of concern
CWA- Clean Water Act
MCUL - minimum cleanup level
PCB - polychlorinated biphenyl
SMS - sediment management standards
SQS - sediment quality standards

12.0 THE SELECTED REMEDY

12.1 SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY

Alternative SD7 (Dredging with Excavated Confined Aquatic Disposal) has been chosen as the selected remedy for the marine environment at OU B. Alternative SD7 is protective of human health and the environment and provides the best overall effectiveness proportional to its cost. Key factors that led to selecting Alternative SD7 include the following:

- Alternative SD7 includes provisions for concurrent management of navigational sediments that are not suitable for open water disposal. Combining the dredging and disposal operations of the two projects enhances the overall implementability, and minimizes the short- term environmental effects, of the separate projects. Combining the actions will also accelerate the implementation timeframe of the cleanup significantly. Alternative SD2 would not provide these benefits.

- Alternative SD7 is equally effective over the long term, compared with Alternative SD2.

- Alternative SD7 has lower short-term risks to workers and the community associated with implementation, compared with Alternative SD2.

- Alternative SD7 has a lower cost than Alternative SD2.

Under Alternative SD7, the dredging, disposal, capping, and enhanced natural recovery measures will immediately remove the sediments containing the highest PCB concentrations from the biologically active portion of the marine environment. Shoreline stabilization will minimize the potential for future erosion of COCs from soil to the marine environment. Further long-term risk reduction is expected as a result of natural recovery of sediments throughout Sinclair Inlet. The institutional controls and monitoring requirements will maintain and verify the long term effectiveness of the remedy and, if necessary, control future human exposure to COCs in marine tissue.

12.2 DESCRIPTION OF THE SELECTED REMEDY

The selected remedy, depicted in Figure 12-1, includes the components described in the following subsections.

12.2.1 Dredging of Sediments

Sediments with PCB concentrations greater than the remedial action level of 12 mg/kg OC will be removed by dredging. Sediments will also be dredged in areas where mercury concentrations exceed 3 mg/kg and PCB concentrations exceed 6 mg/kg OC. An accumulation of sediments above the level of the sill at the mouth of Drydock 1 will also be dredged. While PCBs in this area are below 6 mg/kg OC, mercury has been found above 3 mg/kg nearby. Unless the accumulated sediments are removed future drydock usage is likely to resuspend the sediments and put them into circulation in the inlet. The conceptual design for dredging is shown in Figure 10-4.

The combined area of sediments to be dredged is approximately 32 acres. The remedial design will require that areas targeted for dredging be dredged to a minimum depth of 2 feet. With an allowance for overdredge depth and side slopes, the volume of impacted sediments to be dredged for environmental remediation is estimated at 200,000 in-place cubic yards. Dredging will be accomplished mechanically with a clamshell bucket or functional equivalent. The selection of specific equipment, such as the type(s) and size(s) of mechanical dredging buckets, and use of an environmental bucket, will be accomplished in the remedial design.

The conceptual dredge design shown in Figure 10-4 may be modified during the remedial design as more information on logistical constraints becomes available. The intent of the remedial design will be to remove sediments with contaminant concentrations greater than the remedial action levels. However, practical constraints such as vessel moorage requirements, slope stability considerations, and safety issues will be taken into account during the remedial design, and alternative FSSUs may be dredged to accomplish a similar reduction in area-weighted average contaminant concentrations. It is expected that there will be instances in which the FSSUs targeted for dredging do not exactly correspond to the areas exceeding the remedial action levels.

Debris or other solid waste may be encountered and removed during sediment dredging. Material that cannot be recycled will be sampled and characterized for off-site disposal. All off-site treatment, storage, and disposal of CERCLA waste will occur at facilities that are acceptable under the off-site rule (40 CFR 300.440).

Because the short-term risks to construction workers are considered to be greater than any long-term risk reduction accomplished by under-pier dredging, no under-pier sediments will be dredged.

12.2.2 Confined Aquatic Disposal

CAD Cell Construction

CERCLA sediments and unsuitable navigational sediments will be disposed of in one or more excavated CAD cells constructed on Navy-owned submerged land. The excavated CAD cells will be constructed off the OU A shoreline in Sinclair Inlet, in the approximate location shown in Figure 10-4. The CAD cells will consist of one or more pits excavated into the native sediments and occupying approximately 10 acres. The pits will be sized to hold the expected quantities of both CERCLA and navigational sediments, nominally estimated at 300,000 in-place cubic yards.

The proposed conceptual design for the offshore CAD cells is shown in cross section in Figure 10-5. The dimensions of the cells may be modified during the remedial design to account for variation in the quantity of sediment requiring disposal. Equipment selection for construction of the CAD cells and placement of the contaminated sediments will be determined in the remedial design.

Mechanically dredged CERCLA and unsuitable navigational sediments will be. placed in the excavated CAD cells. After receiving the contaminated sediments, the pits will be capped with a nominal 3-foot-thick layer of clean import material and/or sediments in accordance with the substantive requirements of the 401 water-quality certification. The final elevations will approximately match the original bottom contours. Specific design elements of the cap may be modified in the remedial design, including required consolidation periods, modifications to the required cap thickness, or the need for importing additional capping material such as gravels or sands. Such changes will be considered to account for desired permeability, to provide armoring against anchor damage, to improve constructibility, or to provide habitat enhancement. Cap placement techniques will also be determined in the remedial design.

Management of Sediments from CAD Cell Excavation

Disposition of the excavated material from the CAD cell construction will include a combination of the following elements.

- Disposal of surface sediments within CAD cells. Approximately 4,000 cubic yards of surface sediments from the CAD cell area would be unsuitable for open water disposal. If the final design of the CAD cell includes excavation of the unsuitable material, it would be disposed of within one or more of the CAD cells.

- Final cap at the CAD cell. To provide clean capping material, a portion of clean sediments from the CAD cell excavation will be stockpiled on the bottom of Sinclair Inlet, next to the pit. The stockpile will be maintained at a suitable slope to prevent sloughing. An estimated 14,000 cubic yards of clean sediments will be stockpiled for this use. After disposal of the contaminated sediments, and placement of the 3-foot-thick capping layer, the stockpiled sediments will be re-dredged and placed as the final capping layer.

- Source material for enhanced natural recovery, in situ capping, and habitat restoration. A total of approximately 60,000 cubic yards of clean sediments from the CAD cell excavation may be used in areas offshore from OU A to accomplish the enhanced natural recovery and in situ capping actions (described below). The objective would be beneficial use of the sediments to adjust thickness of the thin-layer and thick-layer caps near the OU A shoreline to create a more gentle slope and improve habitat. The final contours of the capping/habitat enhancement measures will be determined in the remedial design.

- Disposal of excess clean sediments at a DMMP site. Any clean sediments not used for the above purposes will be placed in an approved open water disposal site, such as the Elliott Bay DMMP site.

12.2.3 Enhanced Natural Recovery

To accelerate natural recovery, clean sediment will be placed in a thin layer cap in the area shown in Figure 10-4. The thin layer cap will have a nominal thickness of at least 20 cm. To provide smooth transitions in cap contours and to accomplish the habitat restoration (described below), the thickness of the thin-layer cap may be increased in some areas. This layer is not intended to provide a complete “seal” over the bottom, but will provide a layer of clean sediment in which existing organisms establish themselves. The intent of this action is to reduce the contaminant concentrations to which the organisms are exposed, minimize short-term disruption of the benthic community, and effectively accelerate the effects of natural sediment deposition.

To avoid interference with present or potential fixture navigational requirements of deep-draft vessels at the shipyard, thin-layer capping will be limited to areas that are outside the navigation lanes (“ no-cap boundaries” in Figure 10- 4).

To accomplish dilution of the carbon-normalized PCB concentrations in the existing sediments, the capping material will be required to have an average organic carbon content of approximately 1 percent or greater. The capping material must also be suitable for open-water disposal, as determined by the requirements of the DMMP and have contaminant concentrations below the a cleanup goals. Selection of the capping material source will be accomplished in the remedial design. Beneficial use of clean sediments from the CAD cell excavation as capping material will be considered in the remedial design. It is noted that the fine-grained cohesive nature of this material may result in uneven cap placement.

12.2.4 In Situ Capping

In the nearshore area of OU A, FSSUs F3, F4, and F6 will be capped by placing a nominal 3-foot-thick layer of material over the existing sediments. To provide smooth transitions in cap contours and to accomplish the habitat restoration (described below), the thickness of the cap may be increased in some areas. Previous shoreline construction has been implemented in this area as part of the selected remedy for OU A. The OU A shoreline remedy extends up to 100 feet seaward of the shoreline. The cap in this area will not extend over the existing OU A shoreline remedy. The areas of capping and the existing OU A shoreline remedy are shown in Figure 10-4.

The cap will be constructed as needed to withstand erosional forces while providing improved habitat. Selection of the capping materials will be accomplished in the remedial design. Beneficial use of clean sediments from the CAD cell excavation as capping material will be considered in the remedial design. However, it is noted that the fine-grained cohesive nature of this material may result in uneven cap placement.

12.2.5 Habitat Restoration

Additional action in the OU A shoreline area may include placement of sediments and/or other imported materials to create a more gently sloping shoreline in intertidal and subtidal elevations. These actions will be accomplished by increasing the thickness of the thin-layer cap and in situ (thick-layer) cap in nearshore areas south of the existing OU A shoreline remedy. The intent of placing this additional material is to improve habitat quality in this area. Approximately 30,000 cubic yards of clean sediments would be used to create the desired slopes. A 1-foot-thick layer of imported gravel mix with the appropriate particle sizes for habitat enhancement could be placed at intertidal elevations; this habitat mix will also provide armoring as necessary in intertidal areas to reduce the potential for erosion by wave action. The locations of the habitat improvement actions are shown in Figure 10-4. Figure 10-5 depicts the conceptual approach for the habitat enhancement. Design specifics such as slopes, elevations, and materials selection will be determined in the remedial design.

12.2.6 Shoreline Stabilization at Site 1

Cleanup actions at Site 1 will include dredging of offshore sediments, measures to improve slope stability, and enhanced riprap protection on the shoreline. These actions will be designed to achieve the following performance criteria:

- Minimize human and ecological exposure to eroding fill materials
- Improve slope stability to minimize the potential for future sloughing or erosion
- Accommodate future navigational requirements
- Withstand a prescribed design storm event
- Limit encroachment into marine habitat

Enhanced riprap protection will be provided by importing riprap material and placing it over existing riprap, in the shoreline areas designated in Figure 10-4. The riprap will extend from elevations of approximately –5 MLLW to +18 MLLW. A layer of clean imported material (such as sand) may be placed beneath the new riprap to provide additional containment of fill material.

On the south shoreline of Site 1, dredging will occur below the bottom elevation of the new riprap (i.e., below approximately –5 MLLW). The dredge cuts would be designed to achieve slopes and elevations sufficient to accommodate fixture Mooring Alpha navigational requirements deepening. The dredged face of the fill slope will be capped with imported material to contain any contamination that remains in the existing fill. Slope stabilization measures such as driven sheet piles will be used as needed to strengthen the slope and minimize the potential for sloughing.

On the east shoreline of Site 1, dredging would be limited to the eastern portion of FSSU F58, where the mudline is relatively flat. On the sloping fill surface, a minimum 3-foot-thick capping layer of imported material will be placed below the bottom elevation of the new riprap (i.e., below approximately –5 MLLW) to contain any contamination that remains in the existing fill.

The current estimate of impact from the installation of riprap and sheet pile at Site 1 is approximately 0.1 acre of permanent loss of intertidal habitat. Remaining issues at Site 1 include assessing the total area impacted and a final determination of the type of permanent or temporary habitat loss to the marine environment. Once the extent of habitat impact is confirmed, a mitigation and monitoring plan will be developed and submitted for approval, pursuant to Clean Water Act Section 404(b)(1).

Figure 10-3 shows conceptual approaches that may be used to accomplish these objectives. Design specifics such as slopes, elevations, and materials selection will be determined in the remedial design.

12.2.7 Monitoring

Monitoring During Remedial Action

Monitoring will be conducted during implementation of the remedial actions to evaluate short-term environmental impacts and to verify proper implementation.

The remedial design will incorporate the substantive requirements of water-quality certification specifying monitoring requirements during construction of the remedy. The water column will be monitored during dredging, disposal, and capping operations to ensure that water quality criteria are not exceeded outside the designated dilution zones. The water-quality certification will specify required bathymetry surveys, dimensions of the dilution zones, and short-term water quality monitoring requirements during dredging and disposal. The water-quality certification will define any required mitigating measures such as closed- bucket operational controls or silt curtains. The remedial design will satisfy the applicable substantive requirements of 40 CFR 230 (Guidelines for Specification of Disposal Sites for Dredged or Fill Material), will include a Findings of Compliance (40 CFR 230.12), and will be prepared in consultation with EPA, Ecology, and the DMMP.

Long-Term Monitoring

Long-term monitoring will be conducted to document progress toward and attainment of the cleanup goals and objectives described in Section 9, and to verify the long-term integrity of the remedy. Detailed plans for long-term monitoring of chemical, physical, and biological conditions will be developed following completion of the ROD. EPA and Ecology will review and approve the plans in consultation with the Suquamish Tribe and the appropriate public health and natural resource agencies.

The objectives of the long-term monitoring program are briefly summarized below:

- To verify attainment of the cleanup objectives
- To confirm the physical integrity of the CAD cell and shoreline stabilization measures
- To confirm predicted natural recovery of sediments in marine OU B
- To evaluate the success of the remediation in reducing COC concentrations in fish — tissue as represented by English sole

Sampling specifics will be developed following completion of the ROD. The general components of the monitoring program are summarized below.

Monitoring of CAD and Shoreline Stabilization. A monitoring program will be implemented to verify the long-term integrity of the CAD cap system and the shoreline stabilization measures. The monitoring program will include the following components:

- Sediment core sampling through the CAD cap and into the unsuitable dredge material to demonstrate the continued integrity of the cap and confinement of contaminants
- Physical observations of the structural integrity of the CAD cap and shoreline stabilization measures; these will occur periodically
- Precision hydrographic surveys of the CAD cap and shoreline stabilization measures to detect any physical movement
- Biological assessments of the CAD area to document re- establishment of the benthic community.
- Water quality measurements of the CAD area to confirm that contaminant leaching is not resulting in exceedances of marine water quality criteria

The types and quantities of these monitoring events will be greater in early years than in later years.

Monitoring of Sediments. Surface sediments in Sinclair Inlet will be monitored to verify long-term protection of the environment and to assess the natural recovery of sediment. The monitoring program will consist of sediment sampling and chemical analysis combined with natural recovery modeling. Sediment samples will be collected periodically and analyzed for PCBs, mercury, TOC, and particle size parameters. The results of the sampling program will be documented for the periodic reviews. The specific numbers and types of samples, sampling frequency, and analytical methods could be adjusted in subsequent years after the 5-year review based on the results of the monitoring.

Marine Tissue Monitoring. Marine tissue from Sinclair Inlet will be monitored to assess reductions in COC concentrations in edible seafood and to allow determination of the need for seafood harvest restrictions. English sole tissue samples will be collected periodically and analyzed for PCBs and mercury. The results of the sampling program will be documented for the periodic reviews. The specific numbers and types of samples, sampling frequency, and analytical methods could be adjusted in subsequent years after the 5-year review based on the results of the monitoring.

Marine tissue monitoring results will be evaluated by the Navy, Ecology, and EPA for attainment of the remedial goal of tissue concentrations consistent with reference area tissue concentrations.

In addition to addressing concerns of the Suquamish Tribe, a single round of sea cucumber tissue samples wilt be collected. The sea cucumber samples will be analyzed for PCBs,

Termination of Long-Term Monitoring. Long-term monitoring of marine sediments and marine tissue may terminate when any of the following conditions are met:

- The sediment cleanup goal of 1.2 mg/ kg OC PCB is attained, measured as an area-weighted average. The point of compliance for attaining this goal is the top 10cm of sediment.

- Concentrations of PCBs in English sole from Sinclair Inlet decrease to levels consistent with the cleanup goal.

- The Navy, EPA, and Ecology mutually agree that continued monitoring is no longer providing useful information.

12.2.8 Maintenance

The physical condition of the shoreline stabilization measures and the CAD caps will be maintained to preserve the integrity of the Remedy. The need for any corrective actions or physical maintenance will be identified by review of the results of the monitoring program. Physical maintenance will be provided as needed. The effectiveness of the inspection and maintenance program will be reviewed and evaluated during the periodic reviews.

Monitoring and maintenance will not be conducted for physical habitat restoration features at OU B. These include the final cover at the CAD cap and the shoreline habitat restoration features.

12.2.9 Institutional Controls

Any remedy that results in hazardous substances remaining on site above levels that allow for unlimited use and unrestricted exposure requires some form of institutional controls to ensure that human health and the environment are protected. For the marine portion of OU B, both the CAD cell area and Site I are subject to institutional controls (see Figure 10-4 for exact locations). The specific institutional controls and the objectives of the controls pertaining to both those areas are described below. Since this is an early action ROD for only the marine portion of OU B, facility-wide requirements will be described in the final ROD for OU B, which will include both the terrestrial and marine portions of the operable unit. The final ROD for OU B is expected to be completed within the next year.

Institutional Controls and Objectives for the CAD Cell Area

Land-use restrictions and requirements are needed to address maintenance of the CAD cell cap and procedures for controlling activities that could damage the cap or allow exposure to or release of contaminants. The objectives of the controls are as follows:

- To ensure that the integrity of the cap is maintained
- To prevent any digging or construction on top of the cap
- To prevent dredging on top of the cap

The Navy and others will be able to conduct navigation in this area subject to maintaining the — integrity of the CAD cover and taking necessary preventive measures to protect against damage. The Navy will provide information to the Coast Guard to ensure that appropriate restrictions, such as anchoring restrictions, are implemented to meet the objectives stated above and that the cap is properly indicated on navigational maps.

Institutional Controls and Objectives for Site 1

Land-use restrictions will address procedures for controlling construction and maintenance to prevent activities that may interfere with or compromise the function of the shoreline stabilization system. Since Site I is within the exclusion zone, access to this area is already controlled and limited. The objectives of the controls are as follows:

- Prevent uncontrolled excavation
- Prevent uncontrolled construction

Monitoring and ongoing maintenance will help ensure that the above- stated objectives are met.

12.3 SUMMARY OF ESTIMATED REMEDY COSTS

The anticipated costs associated with the selected remedy are summarized in Table 12-1. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering and design of the remedial alternative. Major changes may be documented in the form of a memorandum in the administrative record file, an explanation of significant differences, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to –30 percent of the actual project cost.

12.4 EXPECTED OUTCOMES OF THE SELECTED REMEDY

The selected remedy will result in no changes to the current land use for submerged land in Sinclair Inlet. Absent further cleanup, institutional controls will be required at Site 1 to maintain the long-term integrity of the shoreline stabilization remedy. Additional restrictions on anchor sizes and future dredging will be required for the area of the CAD cells, to prevent damage to the cap.

The selected remedy for marine OU B has no impact on current or potential future groundwater use at the Complex or vicinity.

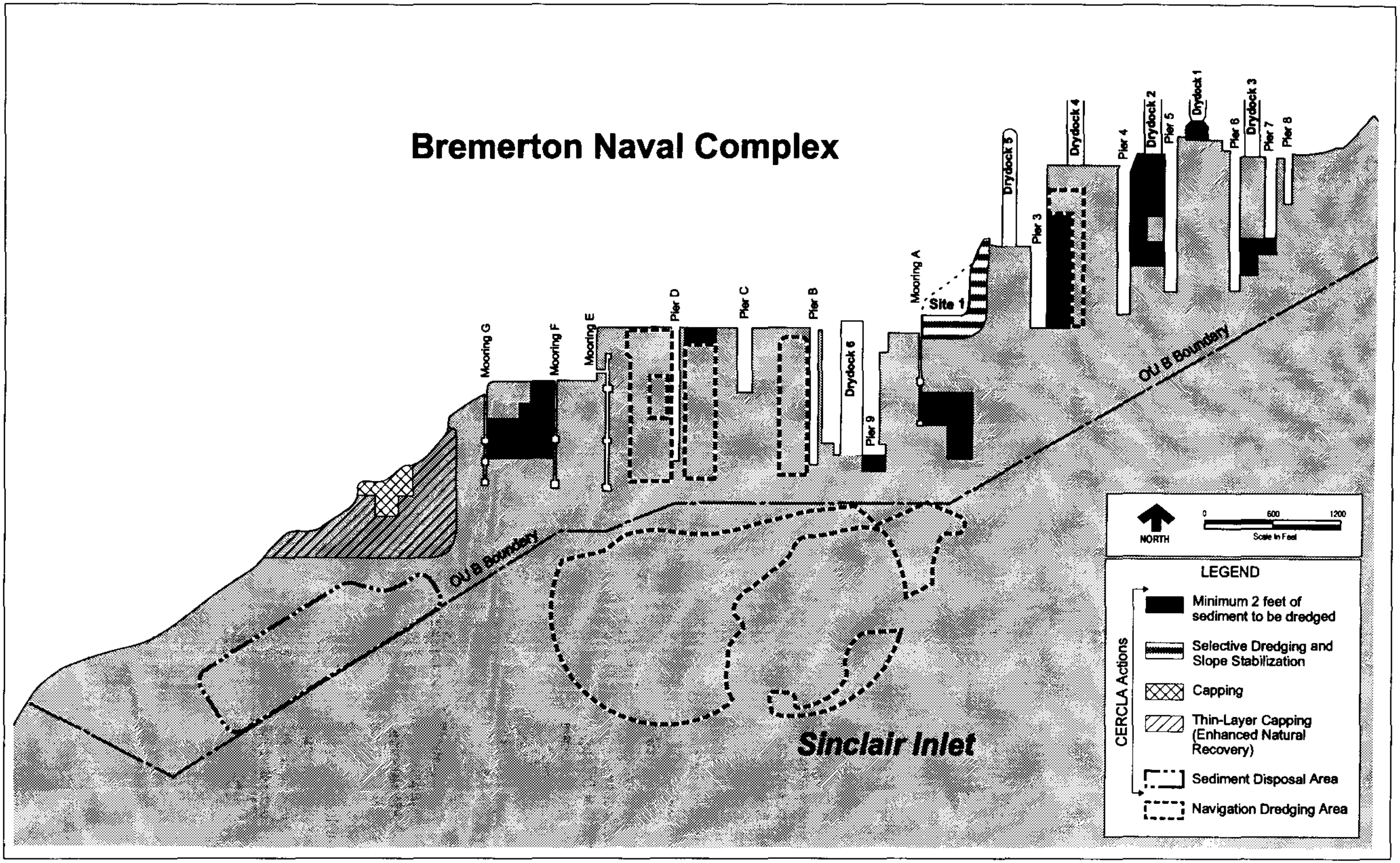
The selected remedy is expected to reduce the area- weighted average PCB concentrations in OU B surface sediments by about 47 percent, immediately following remediation. Also, the shoreline stabilization measures under these alternatives are expected to minimize any recontamination caused by eroding fill material. Natural recovery of sediments is expected to continue over the long term. Current modeling estimates predict that the MCUL of 3 mg/kg OC PCB will be met within 10 years within the marine OU B boundary. In the event that significant improvements in sediment quality are not observed within the first 10 years, the Navy, Ecology, and the EPA will evaluate the need for further actions.

It is expected that the reduction in area-weighted average concentrations of PCBs in surface sediments will eventually result in reductions in PCB concentrations in marine tissue. However, it is not possible to make quantitative estimates of the degree of, or timing of, any reduction in PCB concentrations in marine tissue. Until the concentrations of PCBs in marine tissue reach acceptable levels, it is anticipated that the Suquamish Tribe or WDOH may place restrictions on seafood harvesting from Sinclair Inlet.

The ecological risk assessment identified some potential for ecological risk to marine organisms from the presence of COCs in sediments. Although the selected remedy does not include specific actions designed to address the potential ecological risks, it is expected that the selected remedy will result in cleanup of sediments that may be contributing to the potential ecological risks.

Physical, sediment chemistry, and English sole monitoring is expected to continue until the cleanup goals are met, or upon mutual agreement of the Navy, EPA, and Ecology. It is anticipated that the scope of the monitoring program will be modified over time, as a result of periodic reviews of the monitoring data. Monitoring of marine sediments and tissue is expected to terminate when either the sediment or tissue cleanup goal is achieved.

The final cleanup levels for marine sediments are set in Section 9 of this ROD. Implementing the selected remedies is expected to result in human health risks below 10-5 lifetime excess cancer risk and hazard index of 1.



CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 12-1
Planned OU B Sediment Cleanup

CTO 0131
OU B MARINE
Bremerton, WA
RECORD OF DECISION

53313104-2-041700

Table 12-1
Summary of Estimated Remedy Costs

Description	Quantity	Unit	Unit Cost ($)	Cost ($)
Direct Capital Costs				
CERCLA Dredging	200,000	CY	3.00	600,000
Vessel/mooring relocation	1	LS	750,000.00	750,000
Excavated CAD				
Borings to characterize cell area	1	LS	400,000.00	400,000
Dredge cell(s)	360,000	CY	4.00	1,400,000
Transport and dispose clean sediments	241,000	CY	3.00	723,000
Place CERCLA sediments in CAD	200,000	CY	3.00	6000,000
Place navigational sediments in CAD	100,000	CY	0.00	0
Import and place sand cap	60,000	CY	15.00	900,000
Capping at OU A area				
Place thin-layer cap	20,000	CY	4.00	80,000
Place minimum 3-foot-thick cap	55,000	CY	4.00	220,000
Resource Protection Actions				
Habitat Restoration at OU A				
Place thick layer of sediments	30,000	CY	4.00	120,000
Armor/habitat layer import and place	5,000	CY	23.00	115,000
CAD cell finish cover	14,000	CY	18.00	252,000
Standby for Tribal fishing	1	LS	250,000.00	250,000
Site I Shoreline Stabilization				
Import and place riprap	5,000	CY	23.00	115,000
Import and place quarry spalls	6,000	CY	23.00	138,000
Construct sheet pile stabilizing wall	400	LF	750.00	300,000
Water Quality Controls				
Turbidity Controls	1	LS	400,000.00	400,000
Water quality monitoring (DO and turbidity)	1	LS	60,000.00	60,000
Sampling boat/equipment rental	90	DAY	800.00	72,000
First Year CAD Monitoring				
Bathymetry survey	6	EA	5,000.00	30,000
Sidescan sonar	3	EA	5,000.00	15,000
Sediment profile camera survey	4	EA	5,000.00	20,000
Surface PCB sediment sampling	20	EA	1,000.00	20,000
Shallow borings (visual and physical)	20	EA	1,000.00	20,000
First-Year Sea Cucumber Monitoring	1	LS	60,000.00	60,000
TOTAL DIRECT CAPITAL COSTS (DCC)				7,700,000
INDIRECT CAPITAL COSTS				
CAD Monitoring/Maintenance Plan	1	LS	30,000.00	30,000
Monitoring Plan for Natural Recovery	1	LS	30,000.00	30,000
Mobilize/demobilize, bond, insurance (10% of DCC)				770,000
Engineering, construction management (15% of DCC)				1,155,000
Subtotal Indirect Costs				1,985,000
Capital/Indirect Contingency (20%)				1,937,000
TOTAL INDIRECT CAPITAL COSTS				3,922,000
TOTAL CAPITAL COSTS				**11,622,000**

Table 12-1 (Continued)
Summary of Estimated Remedy Costs

Description	Quantity	Unit	Unit Cost ($)	Cost ($)
ANNUAL O&M				
Monitoring of Natural Recovery (Annualized)	1	LS	38,040.00	38,040
Marine Tissue Monitoring (Annualized)	1	LS	39,200.00	39,200
Site 1 Shoreline Maintenance (Annualized)	1	LS	16,590.00	16,590
CAD Monitoring/ Maintenance (Annualized)	1	LS	57,095.00	57,095
Periodic Reviews (Annualized)	1	LS	10,000.00	10,000
Subtotal				**160,925**
O&M Contingency (20%)				**32,185**
Total Annual O&M				**193,110**
PRESENT WORTH ANNUAL O&M (30 years, 7%)				**2,396,302**
TOTAL PRESENT WORTH COSTS				**14,018,302**

Notes:
Unit costs include contractor overhead and profit.
O&M costs are annualized.
Present worth of O&M costs assumes a 7 percent discount rate and 30-year duration.
All quantities are estimates that may be refined when remedy is designed.
Cost estimates are within +50 percent to -30 percent accuracy expectation.
CAD - confined aquatic disposal
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CY- cubic yards
DO - dissolved oxygen
EA - each
LF - lineal feet
LS - lump sum
OU A - operable unit A
O& M - operation and maintenance
PCB - polychlorinated biphenyl

13.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, selected remedies must be protective of human health and the environment, comply with ARARs, be cost-effective, and use permanent solutions and alternative treatment technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that use treatment that permanently and significantly reduce volume, toxicity, or mobility of hazardous substances, pollutants, or contaminants as their principal element, and a bias against off-site disposal of untreated waste. The selected remedy for the marine environment at OU B, Alternative 5D7, is discussed in terms of these statutory requirements in this section.

13.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will protect human health and the environment by consolidation and containment of contaminated sediments, enhanced natural recovery, in situ capping, stabilizing shoreline areas to minimize the potential for erosion and recontamination, and implementing institutional controls that will maintain the long-term physical integrity of the remedy.

The primary human health risks associated with the marine environment are through consumption of English sole that contain PCBs. The estimated lifetime excess carcinogenic risk from this pathway, assuming a subsistence-level consumption rate, is 4.4 x lO-4 The sediment cleanup actions will reduce the concentrations of these chemicals in surface sediments, but will not directly reduce the currently estimated risks from seafood consumption. It is expected that the selected remedy will eventually result in reductions in contaminant concentrations in marine tissue from Sinclair Inlet, with a corresponding reduction in human health risk.

Data from post-remediation sediment and tissue monitoring will be made available to other agencies to support consideration of possible restrictions on harvesting and consumption of marine species. Any such restrictions would be administered by the Bremerton- Kitsap County Health Department, WDOH, or the Suquamish Tribe.

The selected remedy poses no short-term risks to human health or to threatened or endangered species that cannot readily be controlled. Some short term impacts to benthic organisms are expected in the locations targeted for dredging, CAD cell construction, enhanced natural recovery, and capping actions. No adverse cross- media impacts are expected from the selected remedy.

13.2 COMPLIANCE WITH ARARS

The selected remedy will comply with federal and state ARARs that have been identified. No waiver for any ARAR is being sought or invoked for any component of the selected remedy. The ARARs identified for this remedy are discussed in the following subsections.

13.2.1 Chemical-Specific ARARs

Washington State Sediment Management Standards (Chapter 173-204 WAC). These regulations are applicable to the selection of sediment cleanup levels (Chapter 173-204-570 WAC) and selection of cleanup actions (Chapter 173-204-580 WAC). The selected remedy will comply with the requirements of these regulations by achieving sediment cleanup levels documented in this ROD.

Washington State Model Toxics Control Act (Chapter 70.105 RCW; Chapter 173-340 WAC). The overall cancer risk and hazard index requirements (Chapter 173-340, Part WI) are relevant and appropriate when establishing risk-based cleanup levels in sediments for protection of human health. Provisions requiring cleanup levels not to exceed natural background (Chapter 173-340-700[4][d]) are also relevant and appropriate.

Federal Water Pollution Control Act (33 USC 1314; 40 CFR Part 131). These regulations set forth surface water quality criteria for the protection of aquatic organisms and human health (through ingestion of water and aquatic organisms and through ingestion of aquatic organisms only). The criteria for protection of aquatic organisms and protection of human health through ingestion of aquatic organisms are applicable to surface waters of Sinclair Inlet and to discharges of groundwater through the CAD cells and into Sinclair Inlet. The selected remedy will be implemented in such a manner that these water quality criteria are met at designated points of compliance within Sinclair Inlet.

Washington State Water Pollution Control Act; Water Quality Standards for Surface Waters of the State of Washington (Chapter 90.48 RCW; Chapter 173- 201A WAC). Washington State marine surface water quality standards set general water use criteria for class A surface waters and toxic substances criteria for the protection of aquatic life. These criteria are applicable to surface waters of Sinclair Inlet, which Ecology has designated a Class A (excellent) water body. The selected remedy will be implemented in such a manner that these water quality standards are met at designated points of compliance within Sinclair Inlet.

13.2.2 Location-Specific ARARs

Endangered Species Act (16 USC 1531 et seq.; 50 CFR Parts 17, 225, 402). This act protects fish, wildlife, and plants that are threatened or endangered (TIE) with extinction. TIE species that have been observed in Sinclair inlet include chinook salmon, bull trout, Steller sea lions, gray whales, orca whales, and bald eagles. The requirements of this act are applicable to cleanup actions that may affect a listed T/E species or designated critical habitat. The selected remedy will comply with the substantive requirements of these regulations through Navy consultation with the U. S. Fish and Wildlife Service, and the National Marine Fisheries Service (NMFS), As part of the informal consultation process, the Navy has prepared a biological assessment which determined that the remedial action is not likely to affect endangered species.

Marine Mammal Protection Act of 1972 (16 USC 1361-1389; 50 CFR Parts 13, 18, 216, and 222). Marine mammals are occasionally seen in Sinclair Inlet. Should cleanup activities threaten to “take” (including harass) marine mammals in Sinclair inlet, compliance with the substantive requirements of this regulation will be required. The selected remedy will comply with the substantive requirements of these regulations through Navy consultation with the U. S. Fish and Wildlife Service and the National Marine Fisheries Service to determine the need for reasonable and prudent measures or to obtain special permission for incidental take.

Federal Fish and Wildlife Coordination Act (16 USC 661 et seq.). The requirements of this statute are relevant and appropriate to any construction activities where waters of 10 acres or more are proposed to be impounded or diverted, or a channel deepened. The selected remedy will comply with the substantive requirements of this act through Navy consultation with the U. S. Fish and Wildlife Service and the Washington State Department of Fish and Wildlife to determine the need for avoidance or mitigation measures to prevent loss of and damage to wildlife resources.

Marine Protection, Research, and Sanctuaries Act of 1972, Section 103 (33 USC 1401; 40 CFR Parts 227 and 228). This statute and implementing regulations are applicable to the transportation and disposal of dredged material in ocean waters. These regulations authorize the U. S. Army Corps of Engineers and EPA to issue permits for such actions. On-site placement of sediments within the CAD cells, during thin-layer capping, and during in situ capping requires substantive compliance with these requirements. Off-site disposal of sediments from the CAD cell excavation requires Ml compliance with the permitting requirement. The selected remedy will comply with the substantive and, where necessary, administrative requirements of these regulations through Navy consultation with DMMP agencies. The DMMP is discussed under items to be considered (TBC) (Section 13.2.4).

Migratory Bird Treaty Act (16 USC 703 et seq.). The Migratory Bird Treaty Act makes it unlawful to “hunt, take, capture, kill” or take various other actions adversely affecting a broad range of migratory birds, including pigeon guillemots, mallards, ring-necked ducks, double-crested cormorants, and Pacific loons (see 50 CFR 10.13 for list of protected migratory birds) without prior approval by the Department of the Interior. This statute and implementing regulations are relevant and appropriate for protecting migratory bird species identified within Sinclair Inlet. The selected remedies will be carried out in a manner that avoids the taking or killing of protected migratory bird species, including individual birds or their nest.

Aquatic Land Use (RCW 79.90; WAC 332-30). This statute and implementing regulations are applicable to any off- site disposal of sediments from the CAD cell excavation that occurs on state-owned lands. The selected remedy will comply with these requirements by obtaining authorization from the Washington State Department of Natural Resources for any use of state-owned aquatic lands.

Coastal Zone Management Act (16 USC 1451; 15 CFR 923-930). The requirements of this statute are applicable to any construction activities along the shoreline. Proposed actions must be consistent with state coastal zone management (as governed by the Washington State Shoreline Management Act) to the maximum extent practicable.

Washington State Shoreline Management Act (chapter RCW 90.58; Chapter 173-16, 173-22, and 173-27 WAC). The substantive requirements of this statute and implementing regulations are applicable to construction activities along the shoreline (including marine waters and extending 200 feet landward). WAC 173-27-060(1) discusses the applicability of chapter 90.58 RCW to federal lands and agencies within the coastal counties, one of which is Kitsap County. Proposed actions must be consistent with the policies and goals of the approved Washington State coastal zone management program and with the policies and shorelands use designations of the local jurisdiction’s shoreline master plan (Kitsap County shoreline designation maps, WAC 173- 22- 0636). Guidelines for local regulation of shoreline protection (WAC 173-16-060[l7]) are relevant and appropriate for shoreline stabilization. The selected remedy will comply with the substantive requirements of these regulations.

Washington State Hydraulic Projects Approval (chapter 75.20.100-160 RCW; Chapter 220-110 WAC). This statute and implementing regulations are applicable to any work conducted in Sinclair Inlet or along the OUB shoreline that changes the natural flow or bed of the water body (and therefore has the potential to affect fish habitat). The requirements include bank protection (WAC 220-110-050), saltwater technical provisions (-230), and prohibited work times in saltwater areas, such as juvenile salmon outmigration times (-271). The selected remedy will comply with the substantive requirements of these regulations through consultation with the not found to be practicable for the sediments. Because no principal threat wastes are present in the marine environment at OU B, the selected remedy satisfies EPA’s expectation that treatment should be used to address the principal threats posed by a site wherever practicable.

The selected remedy involves on-site containment of contaminated sediments, which is consistent with EPA’s and Ecology’s bias against off-site land disposal of untreated waste. The selected remedy is also consistent with EPA’s expectation for use of engineering controls, such as containment, for waste that poses a relatively low, long-term threat or where treatment is impracticable.

13.7 FIVE-YEAR REVIEW REQUIREMENTS

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action to ensure that the remedy is protective of human health and the environment.

Washington State Department of Fish and Wildlife to determine appropriate mitigation measures for the on- site dredging, disposal, capping, and shoreline stabilization measures.

Native American Grave Protection and Repatriation Act (25 USC 3001-3013; 43 CFR Pan 10). This statute requires that any federal agency discovering Native American cultural items (human remains and associated itinerary objects) notify in writing the U. S. Department of Interior and the appropriate Native American tribe. The federal agency must cease activity in the area of the discovery, make a reasonable effort to protect the items discovered before resuming such activity, and provide notice as described above. These requirements are applicable only if cultural items are discovered during implementation of the selected remedy.

Archaeological Resources Protection Act (16 USC 470aa et seq.; 43 CFR Part 7). This program sets forth requirements that are triggered when archaeological resources are discovered on federal lands. It requires that excavation of these resources be conducted under a permit by professional archaeologists. These requirements are applicable only if archaeological items are discovered during implementation of the selected remedy.

13.2.3 Action-Specific ARARS

Federal Water Pollution control Act Section 404(b)(1), Dredge and Fill (33 USC 1314; 33 CFR Parts 320, 323; 40 CFR Part 230) and Rivers and Harbors Act, Section 10 (33 USC 403; 33 CFR Parts 320, 322). These statutes and implementing regulations are applicable to dredging, filling, and other alteration of the bed of navigable waters in the U. S., including the placement of riprap within the intertidal zone of Site 1. The primary mechanism for regulatory oversight is through permitting by the U. S. Army Corps of Engineers and permit review by EPA. Off-site disposal of clean sediments from the CAD cell excavation may require a permit. On-site actions will comply with the substantive requirements of the Corps of Engineers Nationwide Permit 38. In addition, EPA review of the action under 40 CFR Part 230, Section 404(b)(l), Guidelines for Specification of Disposal Sites for Dredged or Fill Material, will apply. The selected remedy will comply with the substantive and, where necessary, administrative requirements of these regulations.

Washington State Model Toxics Control Act (Institutional Control Requirements) (Chapter 70.105 RCW; Chapter 173-340-440 WAC). This statute and implementing regulations are relevant and appropriate to implementation of institutional controls that are required to maintain the long-term integrity of the cleanup actions. The institutional control components of the selected remedy will comply with the substantive requirements of these regulations.

Washington Water Pollution Control; Water Resources Act; Water Quality Standards for Surface Waters of the State of Washington (RCW 90.48, 90.54; WAC 173-201A). This regulation is an action-specific ARAR because it sets requirements for meeting surface water quality standards during implementation of the remedy. Ecology has designated Sinclair Inlet as a Class A (excellent) water body. The Water Quality Standards for Surface Waters (WAC 173-20 IA) will apply during CAD construction including turbidity and mixing zone requirements. They will also apply to long-term monitoring of the CAD cell(s).

Maximum Environmental Noise Levels (WAC 173-60). These regulations are applicable to the implementation of the remedial action. The regulations establish permissible, maximum noise levels for various receptors based upon the source receiving the noise.

Resource Conservation and Recovery Act; Washington Dangerous Waste Regulations (40 CFR 260; WAC 173-303. These requirements apply to the management and disposal of hazardous/dangerous wastes at an off-site facility. These regulations are only applicable if RCRA wastes are encountered during the dredging operation. Off-site disposal would then comply with substantive and administrative requirements of these regulations. These regulations are not applicable to the disposal of sediments in the CAD.

Solid Waste Management Reduction and Recycling (RCW 70.95 and WAC 173-304-200). On-site management of solid waste encountered during the dredging operation will be managed in accordance with the substantive provisions of the solid waste regulations. Solid wastes will be sent to a permitted solid waste facility. These regulations are not applicable to dredged or fill material.

13.2.4 Items To Be Considered

Dredged Material Management Program. The DMMP, formerly known as the Puget Sound Dredged Disposal Analysis (PSDDA) program, establishes evaluation procedures for assessing the suitability of dredged material for unconfined open water disposal in Puget Sound. The program was established in 1988 by the U. S. Army Corps of Engineers, EPA, the Washington State Department of Natural Resources, and Ecology. DMMP guidance for sediment evaluation provides specifications for compliance with the Marine Protection, Research, and Sanctuaries Act, Section 103 (33 USC 1401; 40 CFR 227,228). Substantive and administrative requirements of the DMMP are applicable to the off-site open water disposal of clean sediments from the CAD cell excavation. The selected remedy will comply with the DMMP requirements.

Guidance for Subaqueous Dredged Material Capping. This guidance provides suggested methods and design specifications for subaqueous dredged material capping. It also includes monitoring guidelines. The CAD cell cap will be designed using the elements of this guidance.

Guidance for In Situ Subaqueous Capping of Contaminated Sediments. This guidance provides suggested methods and design specifications for capping of in situ contaminated sediments. It also includes monitoring guidelines. The in situ capping and thin-layer capping components of the selected remedy will be designed using the elements of this guidance.

13.3 OTHER FEDERAL LAWS

Point Elliott Treaty of 1855. The United States, including federal agencies, has a duty to protect treaty fishing rights reserved by the Suquamish Tribe and defined by court decisions and orders. The Suquamish Tribe is a signatory to the 1855 Treaty of Point Elliott, whereby the Tribe ceded certain of its aboriginal lands to the United States but reserved under the treaty “the right of taking fish at all usual and accustomed grounds and stations.”

13.4 COST-EFFECTIVENESS

The selected remedy is cost-effective and represents a reasonable value for the money that will be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (40 CFR 33.430ffl(1)(ii)(D). This was accomplished by evaluating the overall effectiveness of the alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and were AR. AR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness.

The estimated present worth cost of the selected remedy is $14,000,000. The removal and off-site disposal actions under Alternative SD2 would cost approximately twice as much as the selected remedy, would pose potentially greater short-term risks to construction workers and the community, and would not provide significantly greater long-term protection. Neither of Alternatives SD2 or SD7 would include actions to provide reduction in toxicity, mobility, or volume through treatment. Therefore, the selected remedy provides greater overall effectiveness at less cost than Alternative SD2. The relationship of the overall effectiveness of Alternative SD7 was determined to be proportional to its costs and hence the selected remedy represents a reasonable value for the money that will be spent.

13.5 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARAR, the selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, short-term effectiveness, implementability, cost, and reductions in toxicity, mobility, or volume achieved through treatment.

The selected remedy meets the statutory requirement to use permanent solutions to the maximum extent practicable. However, treatment was not found to be practicable for sediments at OU B because of the unknown long-term effectiveness of certain treatment technologies, poor implementability, and disproportionate costs of potential treatment technologies. Long-term effectiveness is achieved by the selected remedy through monitored engineering controls and institutional controls, rather than treatment.

13.6 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy does not include treatment that reduces the toxicity, mobility, or volume of waste. As explained in the previous subsection, treatment was not found to be practicable for sediments at OU B.

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (40 CFR 300.430(a)(1)(iii)(A)). EPA has also established an expectation for use of engineering controls, such as containment, for waste that poses a relatively low, long-term threat or where treatment is impracticable (40 CFR 300.430(a)(l)(iii)(B)). The "principal threat" concept is applied to the characterization of source materials at a Superfund site. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or air, or acts as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur.

The contaminated sediments in the marine environment at OU B that are addressed by this ROD are not considered to be principal threat wastes. They are not highly toxic or highly mobile, and they can reliably be contained. Further, as explained in the previous subsection, treatment was

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan for marine OU B was released for public comment in March 2000. The proposed plan identified Alternative 5D7, Dredging With Excavated Confined Aquatic Disposal, as the preferred alternative for marine sediment remediation. The Navy. Ecology, and the EPA reviewed all written and oral comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the proposed plan, were necessary or appropriate.

15.0 RESPONSIVENESS SUMMARY

The following questions were asked during the March 22, 2000, public meeting regarding the proposed marine OU B cleanup. The questions are paraphrased from the record of that meeting.

*1. **Comment (Richard Belmont)**: Has the Navy found any geoducks in the area where the pit CAD will be located?*

Response: The Navy conducted a biological habitat survey of the pit CAD area using an underwater video camera in late summer 1999. This survey was designed to systematically identify flora or fauna along evenly spaced transect lines. Analysis of survey results indicated that the CAD pit area constitutes relatively low-quality habitat in terms of number, density, and diversity of species relative to other areas of Puget Sound. Specifically, a total of five clam siphons were observed in the CAD pit area based on analysis of representative survey transects. These siphons could not be identified to species, but were most likely geoduck or horse clams based on the relatively large size of the siphons. Based on this analysis, the estimated density of these larger clams was 0.0008 individuals per square foot in the pit CAD area, which is a very low density. Thus, if geoducks occur in the CAD area, they occur in very low numbers and density.

***2. Comment (Scott Pozarycki and Richard Belmont)**: Assuming geoducks did exist at the pit CAD location in the future, would harvesting of them be allowed over the CAD? In a case like this any harvesting would probably be done with hydraulic methods, which would probably involve removing afoot and a half of sediment.*

Response: As described above, the results of the video survey at the CAD pit area suggest a low density of large clams in this area (0.0008 individuals per square foot). The site is considered low-quality habitat relative to other areas of Puget Sound. Thus, although geoducks could potentially occur in the CAD pit area, they are not expected to occur in sufficient numbers to represent a significant resource or valuable harvest. The Navy’s recent Aquascape environmental literature compilation noted that geoducks are not expected to be a significant resource within Sinclair Inlet. With respect to the potential effects of geoduck harvesting techniques in the CAD area, the total thickness of the CAD cap will be 4 feet (3 feet of clean imported sand followed by a final 1 foot of clean native sediment). The Navy will likely implement institutional controls to maintain the integrity of this CAD cap. The Navy would maintain institutional controls to avoid compromising the integrity of the cap. Geoduck harvesting methods would have to be assessed to assure that they would not impair cap integrity.

***3. Comment (Sue Gazarek):** Has the Navy done any testing to determine whether these fine sediments which could have chemicals stuck to them will actually settle out once they have been stirred up, or will they increase the turbidity in Sinclair Inlet for a long time?*

Response: Modeling done on behalf of the Navy showed very little risk of release of chemicals and only limited increase in turbidity within 300 feet of the dredging and disposal sites using an open clamshell dredge. Since the actual dredging will use an environmental or closed clamshell, the actual releases should be even less than the limited impacts predicted by the modeling. The Navy will conduct work as required by a Section 401 Water Quality Certification, including using the best available dredging and disposal procedures for minimizing turbidity plumes. The Navy will be diligent in the water quality monitoring and make every effort to meet the water quality certification requirements. Operations will be stopped and corrective actions taken should the chemical or turbidity limits specified in the water quality certification be exceeded.

***4. Comment (Lisa Moss):** I know we’re focusing on the marine portion of the site tonight, but are there concerns about contamination moving down to the marine environment from the upland area in the future?*

Response: The results of the Navy’s remedial investigations and subsequent evaluations lead to the conclusion that there is not an immediate threat of upland sources recontaminating the sediments because sources have been controlled and the storm sewer system, the primary potential future threat, will be addressed in the final OU B ROD. Additional details regarding upland OU B will be presented in a proposed plan and record of decision the Navy is preparing, and another public meeting will be held regarding the upland portion of the site in the future.

The following comment on the proposed plan was submitted in writing:

5. Comment(Ben Nelson)*: Enclosed is a copy of my letter to the Bremerton Sun which has not been published as of this date (3/17/00).*

The following is the Text of Mr. Nelson's 2/24/00 letter to the Bremerton Sun: The Suquamish now question the Navy dredging of Sinclair Inlet as detrimental to their fishery. However, the Tribe gill netting of salmon at Gorst has already destroyed 99% of the bottomfish in the area. Their 1989 S. O. K herring project decimated the herring in this area. What has the Tribe done to restore this fishery? What are the results to date? Is the Tribe expecting compensation from the Navy for a fishery they destroyed?

Mr. Nelson's Comment continues: A Tribal Memo admits this loss of herring. What exact area will you enhance for smelt spawning? Removing the sediment to a land area would be my preference.

Response: The Navy plans to undertake measures believed by the Tribe and other resource organizations to be favorable for marine habitat along OU A. The specific objective of this action is to create a gently sloped nearshore area resembling pre-development conditions. II is hoped that the result will be more favorable for a variety of shallow-water habitat uses, possibly including smelt spawning.

The following comments on the proposed plan were submitted in writing by the Suquamish Tribe (Tribe):

6. Comment (Tribe): *The Tribe fully supports removal of contaminated sediments from the marine environment However, the Tribe is against disposal of these same contaminated sediments back into the marine environment in any GAD facility. This would result in unnecessary habitat degradation as described in the Proposed Plan and leaves open the possibility that contamination can be uncovered and adversely affect the marine system in the future. It is assumed that some contaminated sediment will be spilled or drift to areas around the perimeter of the GAD due to technical limitations. What is the potential for this? What is the estimated time until PCBs deposited in the GAD will be broken down? Does this method simply entomb PCBs effectively 'preserving' them forever?*

This disposal decision ultimately boils down to cost There is a $20 million cost savings by disposing contaminated sediment in the GAD compared to disposal in a landfill. Given the fact that there will be some additional habitat degradation associated with the CAD disposal method, this cost savings should at least in part be used to offset the adverse habitat impacts. Based on the history of habitat degradation in Sinclair Inlet, this should be of paramount priority for the Navy. Instead of merely pocketing the savings, lets use a percentage to restore the habitat.

Response: Disposal of sediment in a pit CAD will cause short4erm impacts. The most pronounced impact will be temporary elimination of existing benthic creatures during CAD excavation. However, these short-term impacts appear relatively minor compared to the potential water quality impacts from sediment dewatering and human health impacts associated with transportation necessary for upland disposal.

Short-term impacts will be minimized through environmental controls, sound work practices, and equipment selection. The water quality certification that will be issued for this project will require collecting surface sediment samples around the perimeter of the CAD at the beginning of the project. These samples will be analyzed for a variety of chemicals including PCBs. The certification will also require sample collection prior to placement of the finish layer of native sediments over the CAD. In addition, long-term monitoring of the CAD will be instituted to ensure that the contaminants are not escaping into the marine environment.

PCBs are persistent chemicals that break down only very slowly under natural conditions. High-temperature incineration, the standard method of destroying PCBs, would be very costly and impractical considering the relatively low concentrations of PCBs and the large volume of water that would have to be driven off of the sediments. Local environmental concerns and community opposition could be expected to any attempt to site an incinerator in the vicinity. The most appropriate approach to remediation under these circumstances is to contain the sediments and reduce the chance of contact. PCBs are almost insoluble in water but have a strong affinity for fine sediment particles. The design of the pit CAD will result in the sediments being surrounded by existing fine-grained sediments and covered with a thick layer of imported fine sand which collectively will act to prevent release of

PCBs. In the long term the Navy's analyses suggest that the pit CAD is at least as effective as upland disposal.

Remedy cost is one of nine standard criteria established for comparing alternative cleanup approaches under Federal Superfund regulations. Pit CAD disposal ranked significantly better than upland disposal on costs as well as on short-term impacts. It is misleading to use the term "savings" for the difference in projected costs for these two alternatives, since this could be taken to imply that $30,000,000 has been pre-allocated for cleanup.

7. Comment (Tribe): *Sediment capping near OUA represents a clear opportunity to attempt some restoration to 'natural' shoreline conditions at this site. A habitat problem widely recognized in Sinclair Inlet is the lack of nearshore habitat Discussions between the Navy and the Tribe about a small project in conjunction with sediment capping just west of the shipyard are encouraging. The goal of this project should be to create gradual sloping shallow subtidal and intertidal habitat up to the high water mark This would create surf smelt spawning areas, shellfish beaches, and shallow nearshore salmon rearing areas. This particular project has promise and the Tribe encourages the Navy to continue to develop this. A potential habitat restoration project at this same site has been identified by the Navy and Tribe as possible mitigation for the Pier D project. This latter project would involve excavation of fill material and restoration of upper intertidal habitat It is the Tribe's hope that this latter project will be carried forward and that it could and should be coordinated with the CERCLA sediment capping.*

The Tribe has been working with the Navy to identify other habitat projects along the north shore of Sinclair Inlet and again we are encouraged by these efforts and the commitment the Navy is making to address the habitat degradation that has occurred The Tribe encourages the Navy to continue these efforts and to restore as much nearshore habitat as possible within the framework of this CERCLA cleanup.

Response: The Navy routinely endeavors to consider the broader picture and identify opportunities to achieve multiple objectives when developing remedial actions. While working with the Tribe throughout the development of the OU B Marine Remedial Action, such an opportunity was identified. It is now planned to augment the thick-and thin-cap requirements for the sediment units off OU A with beneficial use of clean sediments. As the Tribe suggests, the capping requirements are expected to be implemented in a manner that will create additional habitat. The proposed beneficial use is not inconsistent with the current concept for habitat restoration identified by the Navy and Tribe as possible mitigation for the Pier D project.

8. Comment (Tribe): *The Tribe requests a meeting between Navy contractors and Tribal fisherman two weeks before the commencement of dredging so that all parties understand exactly what will be occurring and potential conflicts can be avoided to the greatest extent possible. The Tribe is concerned about the effect of dredging and in-water construction on Treaty reserved fishing rights in Sinclair Inlet The Tribe conducts a chinook salmon fishery from mid-July to mid-September in Sinclair Inlet with tribal fishers typically placing fishing gear in close proximity to the BNC as this is where the fish congregate. We are concerned access to this Treaty reserved resource will be restricted either by equipment, operations, or Navy ships currently docked at the BNC which must be moored in central Sinclair Inlet in order to allow access for dredging and construction. Continued discussion is required on this important issue.*

The Tribal chum salmon fishery takes place from mid-October to the end of December at the very eastern boundary of Sinclair Inlet as these fish move into Dyes Inlet. Barge traffic between Sinclair Inlet and Elliott Bay has the potential to disrupt this fishery, The Navy has stated that barge traffic will be restricted to the ferry lanes. This may alleviate much of the concern regarding interference with Tribal fishing; however, the ferry itself often interferes with net placement during this fishing season so the Tribe suggests close communication between the Navy and Tribal fisherman to avoid potential conflicts.

Response: The Navy is committed to working with the Suquamish Tribe to minimize impacts. Based on a request from the Tribe, the Navy expects to shut down the dredging operations for a two-week period during the peak fishing season in August. The Navy will also schedule a meeting, to be facilitated by the U. S. Coast Guard, with the Tribal fishermen and the dredging contractors to ensure there is communication between these groups. There is no expectation that vessels presently moored within the exclusion zone will be relocated to the mooring buoys in the central portion of Sinclair Inlet to support dredging.

9. Comment (Tribe): *Site 1 remedy. As stated in comment #2, a habitat problem widely recognized in Sinclair Inlet is the lack of nearshore habitat. The upper intertidal area in particular has been filled and otherwise eliminated all along the north shore of the Inlet Shallow subtidal areas are also uncommon. This type of habitat is important for juvenile salmon, shellfish, baitfish, and myriad other species. Even though site 1 habitat is already degraded due to steep slopes and riprap armoring, the site 1 remedy continues the pattern of steepening and deepening the shoreline that has been occurring throughout the history of the BNC. The optimal remedy here is to remove fill or cap the area to create a more natural shoreline. Since operational constraints of the shipyard prevent this and since this remedy is in large part driven by a future MILCON project, this is further justification for the Navy to restore habitat elsewhere in Sinclair Inlet While the Tribe accepts the fact that the working shipyard requires these kinds of depth/slope patterns, it is difficult to accept a continuation of this pattern without improving the shoreline at another site. This trend of gradually deepening and steepening the north shore of Sinclair Inlet needs to be reversed and some nearshore shallow water habitat restored*

Response: To the extent that the remedial action is being conducted at the shoreline, the Navy has endeavored to consider habitat restoration in selecting a remedy. The comment emphasizes a historical pattern of Navy land use at the Complex that is unrelated to the release or threat of release of a hazardous substance under CERCLA. The Defense Environmental Restoration Program, which finds the remedial action, is designated for the remediation of releases. Habitat restoration work in response to lawful historical land usage is unrelated to the program’s objectives and an inappropriate use of these finds.

The improvements at Site 1 are designed in a manner that minimizes encroachment and avoids creation of bulkheads, while achieving functionality and permanence of the remedy. Permanence is one of nine standard criteria established for comparing alternative cleanup approaches under Federal Superfund regulations. Placement of the erosion control material, in combination with the dredging at the site, will minimize the possibility that sea life will come in contact with contaminated materials. In total, it is considered that the productive fish habitat at Site 1 has been increased.

10. Comment (Tribe)*: Natural recovery is stated to be an important part of this remedy. This should be effective for that part of the shipyard where a depositional environment exists. However, the September 1998 Sediment Trend Analysis of Sinclair Inlet by McClaren indicated that east of pier 4, an erosional environment exists. It was further hypothesized by McClaren that this eroded sediment could be circulated and deposited in other sections of Sinclair or Dyes Inlets. This region of the shipyard therefore requires special attention since natural recovery will not occur and since this may be a source of contamination for other regions of Puget Sound. This is particularly important given that sediment contamination in Ostrich Bay (Jackson Park Housing Complex) is not being remediated because incoming contamination will apparently defeat whatever is done.*

The Navy is planning to dredge most of the sediment contamination in this eastern part of the shipyard However, there are some additional areas with PCBs between 6 and 12 ppm OC and high mercury concentrations which will not be addressed according to the Proposed Plan. ‘Intermediate measures’ such as thin layer capping are suggested by the Navy on page 6for this level of contamination. Since practical considerations such as active berthing areas don’t allow for these ‘intermediate measures! within the shipyard, it is prudent to address this contamination concern through the primary remediation method being employed which is dredging We therefore recommend some additional dredging between piers 4 and 5 and between piers 6 and 7 where PCBs exist at concentrations between 6 and 12 ppm OC. Given the fact that dredging equipment is already scheduled to be operating within these berthing areas and adequate capacity exists in the CAD, this should be easily incorporated into the Navy’s remedial design. The fact that the pit-CAD is a relatively inexpensive disposal alternative is further justification to dredge more contaminated sediments.

Response: Cost-effectiveness was one of the considerations in selecting a PCB action level to guide the cleanup. The costs of removing sediments with PCB concentrations below 12 mg/kg OC were found to be disproportionate to the limited reduction in risk that would be achieved. During development of the proposed plan, only sediment units with PCBs greater than 12 mg/kg OC were originally to be dredged. At the Tribe’s request, additional dredging of areas with lower PCB levels and elevated mercury concentrations were included in the proposed plan. This additional dredging will take place between Piers 4 and 5 and Piers 6 and 7. These additional dredge areas increase the cleanup dredging quantity by 34 percent, which is a substantial portion of the sediment cleanup.

The guidelines developed by the Navy, in consultation with Ecology and the EPA, for defining the additional dredging in the absence of a definitive risk-based rationale were that the PCB levels were to be between 6 and 12 mg/kg OC and the mercury concentration was to be above 3 mg/kg. The remedial action will meet these established guidelines. Any additional dredging would not.

The goal of combining the cleanup and navigation dredging into a single integrated project has been widely endorsed by regulatory and resource agency staff and other stakeholders because of obvious benefits, including reduced impact to the inlet. Achieving this goal promises to be an ongoing challenge, considering the scope of the work and the numerous constraints as to when and how the work can be performed. Incorporating additional dredging in the cleanup at this point would very likely jeopardize the chances of completing the work in a single construction season.

Nevertheless, the Navy will attempt to take advantage of any opportunity that may occur to incorporate dredging of sediment units F78 and F88 in eastern OU B in the cleanup. Work in this portion of OU B is scheduled toward the end of the dredging sequence, increasing the likelihood that this additional work can be included as long as the prior work is completed on schedule. Planned CAD pit capacity should allow for cost-effective disposal of the additional sediments as long as the actual sediment volumes from prior dredging do not markedly exceed forecasts.

11. Comment (Tribe): *Dredging in the erosional area in the eastern part of the shipyard should be conducted during periods of low current velocities as much as practicable so as to minimize the transport of suspended, contaminated sediment to other regions such as Dyes Inlet.*

Response: Ecology and EPA, in consultation with NMFS, are preparing a water quality certification for this project. The certification will establish both monitoring and water quality requirements for the project. These agencies will routinely review the monitoring results and determine if additional protective measures are required. In addition, the project specifications require use of the best available dredging technology for minimizing potential impacts to the marine environment. The specifications also include additional measures to be taken in the event the water quality certification requirements are exceeded. With use of the most protective dredging techniques available, the stringent monitoring requirements, and routine oversight by the regulators, dredging at the Complex will minimize the transport of contaminants,

12. Comment (Tribe)*: Sinclair Inlet contains all sorts of garbage and debris as a result of various dumping and past waste practices. Dredging will likely disturb and possibly remove much of this. According to the RAB presentation of February 22, this debris will be removed when it exists in areas which are scheduled to be dredged There is concern about hazardous materials such as intact drums or batteries which might be ruptured by dredge equipment resulting in release of some contamination. What is the possibility of this and what are contingency plans for this scenario?*

Response: The Navy used divers to perform debris removal around many of the piers in 1995. Based on their report, there is still a good deal of debris left on the bottom. Foster Wheeler Environmental also performed a debris survey in conjunction with the bathymetric survey during the summer of 1999. The results of the debris survey are documented in the project plans and specifications, so that the dredge operator may use this information throughout the dredging.

The potential for intact drums to exist near pier areas is low. Even a full drum usually contains enough head space that it would float if dropped into Sinclair Inlet. If a drum were to sink, it would likely indicate a leak in the drum that would allow water to enter the drum, A hole would also allow liquid in the drum to escape. Any metal drums dropped into Sinclair Inlet would settle near the surface and quickly corrode.

The pier area dredging will be accomplished using 24-to 27-cubic-yard (cy) environmental or shrouded buckets. For comparison purposes, a 55-gallon drum equates to 0.27 cy, or roughly one percent of the bucket volume. The Cable-Arm bucket is designed to be lowered to the area to be dredged and then closed with a flat, level cut to trap the sediments within the bucket. The bucket would close around a loose piece of debris. The debris would then be placed into the barge together with the sediments, where it would be picked out and brought upland for proper disposal. The debris removal requirements are clearly stated in the project plans and specifications.

The Cable-Arm bucket takes a relatively shallow bite, only about 1-foot deep. Large debris could be trapped in the lips of the bucket as it closes. If the debris were a 55-gallon drum, there is the potential for the drum to be crushed by the bucket. This type of situation could result in a release of the drum's contents to the environment. The dredge will be equipped with a spill kit and booms for use in the event of any release to the environment. The Complex Fire Department would also respond to the release. The Complex has emergency equipment and spill booms for use in the containment of any release. The Site Health and Safety Plan will also include emergency response procedures to be followed in the event of any such release.

In addition to these precautions, the dredge will have a spill boom placed around it to contain any hazardous material (such as petroleum, oils, and lubricants) that may be released from the dredge itself.

13. Comment (Tribe)*: Monitoring should include some sampling and analysis of clam tissue for chemical contaminants. Except for limited data on short term exposure of introduced mussels, this type of evaluation is absent from the RI. Human health risks associated with shellfish consumption have also not been thoroughly evaluated The region immediately west of the shipyard proper in front of QUA likely contains shellfish suitable for such an analysis.*

Response: Sediment cleanup with the objective of indirectly leading to decreased levels of chemicals in the tissues of bottom-dwelling fish is expected to yield commensurate improvement for other marine life, including shellfish. Suitable clam habitat at the southwest end of the Complex is comparatively limited and not open to the public; no sampling of shellfish is planned.

14. Comment (Tribe)*: Page 6, first paragraph. The Proposed Plan states that since English sole was used to represent all fish consumed from Sinclair Inlet, this may lead to an overestimation of risk While the risk assessment in general was indeed conservative in nature, this particular point is not accurate. Other species collected from Sinclair Inlet, such as rockfish, actually contain higher concentrations of PCBs than English sole. An argument can therefore be made that using English sole as a surrogate for all species may actually underestimate the true risk Without a detailed analysis of consumption and chemical concentration for all species, it is simply unknown whether using English sole as a surrogate species underestimates or overestimates the actual risk.*

Response: The statement in the proposed plan was purposely made in conditional form. The intent is to indicate that available information suggests it is more probable that use of English sole as a surrogate for all fish consumed from the inlet will lead to overestimation rather than underestimation of risk. Strictly in terms of arithmetic, it is true that higher risks would be associated with a diet consisting largely of rockfish. However, it appears more likely that an actual diet would include more salmon than rockfish considering relative availability and results of ingestion surveys. Since, in general, salmon spend only a fraction of their lives in Sinclair Inlet, a strong case could be made that only a small fraction of the risk from consumption of migratory salmon is potentially a result of conditions in the inlet.

15. Comment (Tribe)*: Page 6, Objectives of Cleanup, first bullet The Tribe's ultimate goal is to harvest seafood from Sinclair Inlet. At present, chemical contamination in seafood caused in large part by the Navy 's historical practices in Sinclair Inlet prevents the Tribe from carrying out this Treaty right The Tribe 's goal is therefore to have Sinclair Inlet cleaned up to a level that permits safe harvesting and consumption of seafood from these waters. The Navy should have a similar goal.*

Response: The Navy strongly supports the goal of improving conditions in Sinclair Inlet for many reasons, including collection and consumption of seafood. The OU B Marine Remedial Action will be a large step towards meeting that goal.

The following comments on the proposed plan were submitted in writing by the Washington State Department of Fish and Wildlife (WDFW):

16. Comment (WDFW)*: WDFW has participated in the series of workshops regarding development of the proposed plan and listened closely to responses about the feasibility of options regarding cleanup efforts at the site. We appreciate that our concerns about fill of nearshore habitat has been taken into consideration. However, WDFW remains concerned that the proposed pit Confined Aquatic Disposal (pitCAD) will not result in cleanup of contaminated sediments, creates excessive disturbance of* *subtidal benthic habitat to excavate the pitCAD, and will be difficult to monitor or access if treatment options become needed or available. The contaminants originated from upland sources and, as such, they should be removed from Sinclair Inlet.*

Of the alternatives under consideration, we continue to support treatment and upland disposal as the best overall solution with the greatest certainty for the protection offish and wildlife resources that inhabit the inlet We are concerned that the permanence of the pitCAD and the long term capacity of it to prevent contact with marine fish and invertebrate resources is poorly understood Likewise, pitCAD monitoring has been inadequate in the past, and this proposal also appears deficient in determining the effects to fish and wildlife resources. If treatment options are currently unfeasible, then storing the contaminated sediments at upland locations would allow easier access when treatments are more feasible rather than dredging Sinclair Inlet a second time.

WDFW is disappointed that the list of alternatives did not include a remedy that would result in the treatment of contaminated sediments. At a minimum, a pilot project for treatment should be initiated for that portion of the contaminated sediments showing the greatest toxicity. WDFW will require additional and clarifying plans of the pitCAD continues to remain an alternative.

Response: The Navy has routinely and continuously coordinated closely with the State of Washington throughout the Superfund process. Most of this interaction has been with the Department of Ecology, since Ecology is the lead state agency for remedial work. The Navy formally introduced the genera! concept of a pit CAD on Navy property to Ecology and EPA representatives in July 1999. Results of extensive modeling and analyses of various elements of pit CAD performance undertaken by the Navy with input from the agencies have been a routine topic of discussion during regular meetings between the Navy and regulators. These analyses have addressed such issues as stability during CAD excavation, the potential for erosion of the CAD cap from natural forces and vessel movements, and long-term stability. The overall conclusion has been that the pit CAD can be expected to be highly stable and highly effective in isolating contaminated sediments and, hence, is well suited for long-term sediment disposal. Navy reports documenting the results of these analyses, as well as the design of the sediment dredging and disposal action to control water quality impacts, have been routinely provided to Ecology and the EPA.

In general, established sediment treatment technologies are most effectively used with limited quantities of sediment with comparatively high concentrations of chemicals. These methods would not be expected to be economically feasible with the large quantities of sediment with relatively low chemical concentrations and high water content proposed for cleanup at OU B.

A potential Navy pilot project to evaluate the effectiveness of eelgrass in bioremediating PCBs in sediments near OU A was cancelled because of agency objections to leaving contaminated sediments in place during the several years likely needed for the test. The Navy arranged to have tests of solidification/stabilization (S/S) methods using inlet sediments performed when it appeared there was a potential demand for the sediments as a construction material. While these tests showed that S/S methods are capable of greatly improving sediment handling characteristics and reducing the potential for release of chemicals, the costs could only be justified if beneficial use rather than disposal was the objective. While the Navy had a strong interest in upland uses for the OU B sediments, a variety of potential applications were determined to be infeasible because of a combination of stakeholder concerns and schedule constraints.

The State is currently working with other agencies to evaluate potential methods of treating contaminated sediments under the regionwide Multiuser Disposal Site (MUDS) program. However, these evaluations are not sufficiently far advanced to serve as a basis for considering treatment as a significant component of cleanup for this site.

17. Comment (WDFW): We understand that the plans for Site One are still under development Our evaluation will continue as the plans become available. However, use of rip rap and sheet pile along a shoreline will not prevent movement of contaminated sediments into Sinclair Inlet Rip rap may minimize erosion of shoreline fill, but it is not a barrier. The shoreline protection proposal should not result in increased encroachment into the nearshore, as is currently proposed in the Biological Assessment dated January 14, 2000. Mitigation for the additional riprap encroachment should be part of the plan, if unavoidable. We prefer a nearshore habitat restoration project be developed for this portion of the project as mitigation.

Response: it is agreed that the use of riprap along a shoreline will not prevent upland material from eroding into an adjacent water body; the riprap merely minimizes potential erosion. A true barrier to erosion, such as a concrete bulkhead, could be constructed, but WDFW has expressed concern over that type of structure and, consequently, that approach has been avoided. Ecology has expressed support for the more habitat-friendly compromise of using riprap, which will reduce potential erosion of fill without the degree of shoreline hardening associated with an actual wall. Please also see the response to Suquamish Tribe comment number 9.

The following specific comments on the proposed plan were submitted in writing by the U. S. Fish and Wildlife Service (USFWS):

18. Comment (USFWS): *Page 1, bullet 2 "No other chemical levels are high enough to justify sediment cleanup." After reviewing the data, we believe that sediment mercury levels found in the shipyard exceed the CSL level and thus should also be addressed in the proposed plan. In fact, on page 5 the document acknowledges that high mercury levels, which exceed U. S. Food and Drug Administration guidelines, found in rockfish have lead to fish advisories in Sinclair Inlet and exemplifies the need to address other contaminants of concern, like mercury, in the cleanup effort.*

Response: The Navy is also concerned about the potential effects of mercury in inlet sediments and tissues. However, the information available to support a rigorous assessment of the risks associated with mercury in the inlet is limited in many respects. For example, there are decided limitations in the present understanding of the distribution of mercury in sediments and tissues, appropriate ingestion rates by species, fraction of a hypothetical seafood diet likely to be collected in the inlet, and the prevalence of seafood species within the inlet. Without improved insights on items such as these, a sediment cleanup based on mercury would be very difficult to justify. Nevertheless, the Navy is committed to including removal of sediment mercury hot spots in the cleanup and will include analyses for mercury in the post remediation monitoring program.

19. Comment (USFWS)*: Page 5, paragraph I and Ecological Risk Assessment. The studies conducted in 1994 and 1995, which revealed minor biological effects to resources from contaminated sediments, were performed prior to the listing of salmonid species as threatened Under ESA both indirect and cumulative effects are considered when reviewing a project and even minor effects can hamper the recovery of the species. We would like to see an ecological risk assessment conducted using the listed bull trout and salmon species.*

Response: The Navy appreciates and shares Fish and Wildlife's concerns regarding ESA-listed species. However, it would not be appropriate to adopt the goals of the ESA as the primary focus of the ecological risk assessment under CERCLA, even if a new RI/FS process for an unstudied site were being initiated today. It is almost certain that there are substantial limits to both the quantity and quality of information available to support such a risk assessment. Collecting sufficient information to perform a risk assessment would likely be a substantial undertaking requiring at a minimum preparation of work plans, extensive field investigations within Sinclair Inlet and at reference locations, and analytical work. Collecting enough tissue data for listed species to be statistically significant might be perceived as an objectionable impact. As a practical matter, even if a complete set of data was available, the time required simply to perform a new ecological risk assessment at this point would preclude coordinating cleanup with the upcoming navigation dredging project.

20. Comment (USFWS): *Page 5, Human Health Risk Assessment. The Suquamish Tribe has recently conducted a new consumption rate study for peoples of the tribe. In light of this new information as well as the PSAMP information aforementioned in this letter, which indicates that bottomfish from Sinclair Inlet contain elevated lead and mercury levels, we suggest that the Navy conduct another human health risk assessment using this relevant information. On page 6, paragraph I, the proposed plan states that using the groundfish, English sole, to represent all types offish eaten may overestimate the risk posed to persons. The new data from PSAMP is a good reminder that there are species for which we do not sample that may be more contaminated than the species we do sample, thus underestimating the risk posed to humans.*

Response: The Navy is also concerned about the implications of the Tribe's survey and recent rockfish analyses. However, several of the points made in the previous response are also applicable to this comment. The new information of itself is not sufficient to support performance of a properly robust new risk assessment. Besides data gaps, there appear to be significant questions yet to be answered about this information. Examples include what fraction of the seafood recorded as being consumed in the recent survey could be expected to be collected from Sinclair Inlet, and how many rockfish could actually be collected from the inlet on a year-to-year basis? Also, as in the previous response, even if all necessary data were available in properly reviewed form, insufficient time remains to perform a new risk assessment and coordinate cleanup with the navigational dredging project.

While the risk assessment process is conservative by design, it is not generally the case that parameter values are selected and assumptions made in carrying out the assessment with the express goal of evaluating the “worst case.” The fact that rockfish samples have been shown to have higher PCB concentrations than were found in the RI English sole sampling does not invalidate the assessment. The new findings suggest that eating rockfish from the inlet may pose greater risk than eating the same quantity of sole from the inlet, but the findings are not sufficient to project overall risk to a subsistence seafood harvester without information on such items as the makeup of the entire diet, availability of rockfish, etc.

21. Comment (USFWS): *Page 6, Objectives of Cleanup. We would suggest adding one more objective to the list namely, to protect and recover threatened and endangered fish species as well as other biological resources.*

Response: The Navy supports the goals of protecting and aiding in the recovery of threatened and endangered species, as well as related goals such as encouraging an increased sense of environmental stewardship towards inlet resources throughout the broader community of stakeholders and resource users. While it is hoped that the cleanup will contribute to the protection and recovery of threatened and endangered species, this is not an appropriate objective of this Superfund cleanup.

22. Comment (USFWS): *Page 6, Objectives of Cleanup, last paragraph. As stated earlier in the general comments we take issue with the natural recovery of persistent, bioaccumulative compounds. Of particular concern to us are the areas with PCB concentrations between 6 and 12 mg/kg OC. The plan states that areas with this concentration range will be “potential candidates for intermediate remedial measures.” We would prefer to see sediments containing this PCB range removed from the water, but at the very least we would urge the Navy to commit to the use of enhanced natural recovery for all these areas if removal is not possible.*

Response: The Navy acknowledges that industrial operations at the Naval Complex have impacted marine sediments in Sinclair Inlet. However, marine sediment cleanup is expensive and will inevitably involve some short- term impacts. To justify undertaking cleanup, elevated chemical levels must be linked to potential risk, and expenditures for cleanup must be demonstrated to achieve reduction in risk. Ideally these connections should be supported by well-established science backed up with specific regulatory requirements.

Levels of chemical contamination measured in Sinclair Inlet are generally comparatively moderate, and only limited justification for cleanup has been identified. The most credible justification for cleanup involves risks to human health from bioaccumulation of PCBs. Note that while the science behind this justification seems well recognized, appropriate regulatory requirements have yet to be filly promulgated.

One consideration in settling on the PCB action level of 12 mg/kg OC was the cost-effectiveness of cleanup. The latest PCB data show that below this level the costs of additional sediment removal are substantial and disproportionate to the limited further reductions in risk that are possible. It could be argued that no action should be taken for sediments with PCB concentrations below the action level. However, the Navy, Ecology, and the EPA agreed that, based on resource agency concerns, efforts would be made to take additional action. Vessel navigation requirements throughout most of marine OU B preclude placing clean material to enhance natural recovery processes, but additional measures are included in the proposed cleanup where conditions allow.

23. Comment (USFWS): *Page 9, last paragraph. The discussion of alternatives seems to bias risks to people (Alternative 2) and does not go into the kind of detail for Alternative 7. A more balanced discussion as to the risks associated with both alternatives is welcome.*

Response: The Navy perceives that the most profound potential impacts related to the cleanup and the impacts that most sharply distinguish the two action alternatives are human health impacts. The Navy also believes that there is not a “balance” of impacts between Alternatives 2 and 7, but rather that Alternative 2 would have considerably more impact than Alternative 7.

24. Comment (USFWS)*: Page 10, Preferred Alternative, bullet 1. A statement referring to the accessibility of contaminated sediments to the dredging process is made. We urge the Navy to use all the means at their disposal and to be innovative to ensure that all contaminated sediments targeted, such as sediments with PCB concentrations 12mg/kg or greater, are removed during the remedial process.*

Response: The Navy will continue to work aggressively to maximize the benefits of the sediment cleanup within the constraints of the project and schedule.

25. Comment (USFWS): *Page 11, Preferred Alternative, bullets 6 and 7. A more detailed explanation as to the institutional controls, the monitoring, and review process must be included in order to evaluate the impacts the project may have on threatened/endangered species as well as other trust species. We feel an evaluation of the monitoring data every 5 years is insufficient and recommend a more comprehensive monitoring and evaluation plan for this project We also recommend building contingencies into the monitoring plan as to how "problems" are dealt with should they arise during the monitoring phase of the project.*

Response: The proposed plan is intended to provide a comparatively brief summary of the proposed cleanup in relatively simplified language suitable for a wide audience. Details of the institutional controls and the monitoring program are under discussion. Some additional information on these topics will be included in the record of decision for marine OU B.

26. Comment (USFWS): *Page 11, Figure 3. At a minimum we urge the Navy to remove all sediments which have mercury contamination co-located with PCB sediment concentrations ranging between 6 to 12 mg/kg OC.*

Response: As noted in an earlier response, information on mercury is not complete enough nor reliable enough to justify making mercury a primary consideration in remedial decision making. However, the Navy will include selective removal of mercury hot spots in the cleanup, and analyses for mercury will be included in the monitoring program.

The following comments on the proposed plan were submitted in writing by the National Oceanic and Atmospheric Administration (NOAA):

27. Comment (NOAA): *NOAA supports the Navy's plan to combine the cleanup dredging with the navigational dredging project. Combining the projects will remove contamination from the water sooner and will avoid separate dredging events. Because dredging disturbs the marine environment by suspending sediment and contaminants in the water column and removing much of the benthic community, it is desirable to limit the number of dredging events.*

Response: The Navy appreciates NOAA's support for the idea of combining cleanup and navigation dredging.

28. Comment (NOAA): *As a general rule, NOAA prefers upland disposal to all types of in-water disposal. However, we recognize both the cost and the difficulties of de-watering and transporting large volumes of sediment offsite. We have reviewed the design for the proposed pit CAD and believe that if built using careful engineering controls and monitored properly, it will provide a cost-effective and ecologically protective disposal solution.*

Response: In addition to higher costs the Navy perceives that substantially greater human health risk would be associated with the handling of sediments if upland disposal had been selected. The Navy is committed to taking the steps necessary to make the project a success, including measures to promote the long-term functionality and integrity of the CAD. The water quality certification for the project will include detailed requirements for monitoring and testing during dredging and disposal, and additional requirements for monitoring in the CAD area will be defined as part of the long-term monitoring program.

29. Comment (NOAA)*: Our primary concern is with the dredging plan and the risk assessment that was used to develop remedial action objectives for the site. NOAA is concerned that the risk of mercury bioaccumulation was not adequately assessed and that the dredging described in the proposed plan may not protect higher trophic level organisms from accumulating harmful concentrations of mercury in their tissues. Several points lead us to this conclusion:*

- *Mercury has been shown in a number of studies to be highly bioaccumulative.*

- *Bioaccumulation was assessed at PSNS by collecting tissues in the field and through the use of a caged mussel study. The caged mussels were suspended one meter above the sediment surface. While this technique is very useful in assessing risk from contaminants dissolved in the water column and associated with suspended solids, it is not useful in assessing risk to organisms feeding directly on the sediments, or to higher trophic level organisms exposed through the food chain. Tissues (English sole, sea cucumber, caged mussels) were collected outside the shipyard boundary away from the most contaminated areas of the shipyard, and may under- represent the potential for bioaccumulation.*

- *The rockfish data available to NOAJ4 indicate that mercury is accumulating to levels of concern (ranging from 0.326 to 1.15ppm) in fish from Sinclair Inlet NOAA begins to be concerned about reproductive or early life stage impacts when whole body concentrations of mercury exceed 0.5 – 1.0 ppm whole body wet weight. More recent studies indicate adverse effects on growth, immune function, testicular development, morphological normality, and feeding ability at concentrations as low as 0.27 ppm. Rockfish populations in Puget Sound are in decline and the National Marine Fisheries Service is currently deciding whether to list copper, brown and quillback rockfish under the Endangered Species Act. NOAA is concerned about the impacts of mercury in Sinclair Inlet on rockfish and other higher trophic-level species.*

We recognize that the mercury data are old (the data were collected in 1994 and 1995) and that conditions may have changed since then. We also acknowledge that source control achieved through upland cleanup work and natural attenuation will work to lower surficial concentrations. However, uncertainties in the risk assessment may have led to inappropriately high remedial action objectives for bioaccumulative contaminant. To address these and other uncertainties in the risk assessment, NOAA has two recommendations:

1) If feasible and if there is sufficient disposal capacity in the CAD, environmental dredging should be extended to include areas with the highest mercury concentrations (above 1.0 ppm), if these areas are not already included in the navigational dredging or the dredging for PCBs.

2) The Navy must monitor the recovery of the area closely, and take additional action if it becomes clear that the site continues to pose a risk to human health or the environment The monitoring program should include mercury and should include both chemical and biological monitoring. Bioaccumulation through the food chain should be specifically addressed in the monitoring plan. NOAA would like to be involved in the development of the monitoring program and to review monitoring results.

Response: Defining the maximum potential bioaccumulation rate that might be experienced by marine life exposed to the highest sediment chemical concentrations at OU B was not one of the objectives of the remedial investigations. No such goal was identified during the period when the Navy, in consultation with Ecology, the EPA, and the resource agencies, planned the investigations. However, both the English sole and sea cucumber sampling do provide insights on the potential impacts of nearshore sediment chemistry at OU B.

To reduce potential interference with Navy vessel movements, none of the English sole sampling was performed in the nearshore area at the Complex, although two of the starting locations are within about 500 feet of the exclusion zone. However, the estimated English sole home range of approximately I mile suggests that these bottom-dwelling fish may wander in an area almost as wide as Sinclair Inlet. On this basis, each of the locations where sole were collected in the inlet was capable of yielding sole that had spent time within the exclusion zone at OUR. Also note that a portion of the sea cucumbers were collected in the nearshore area at the eastern end of the Naval Complex.

The justification for selecting a mercury concentration of 1 .0 ppm (mg/kg) as a basis for additional cleanup is not clear. As noted in the ROD the Navy intends to undertake selective dredging of mercury hot spots in response to community concerns to the extent that numerous schedule constraints and other factors, such as pit CAD capacity, permit. In the absence of a well-established scientific rationale, the Navy, in consultation with Ecology and the EPA, has adopted a mercury level of 3 mg/kg as the cutoff point for this additional dredging.

Not only are the existing sediment mercury data comparatively old, but, with only a few exceptions, the sampling involved single-grab samples collected at relatively widely separated locations. Nevertheless, a pattern of elevated mercury levels is apparent throughout the inlet, and the Navy concurs that future monitoring is important to establish that these conditions do not constitute an unacceptable risk. The long-term monitoring program will include both sediment and English sole tissue monitoring. Mercury will be included as one of the analytes.